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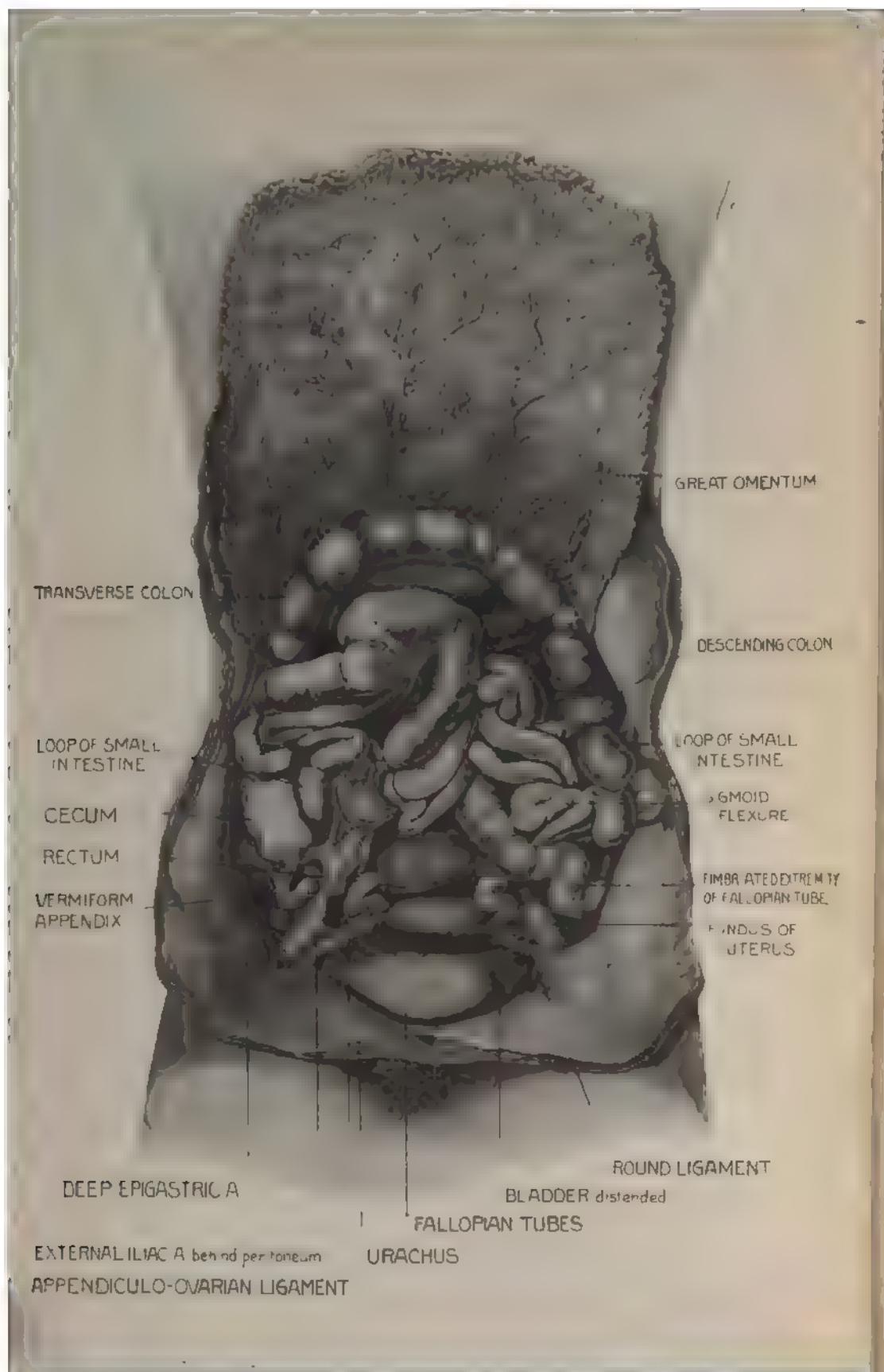
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A
NEW
CLINICAL SURGERY

BY

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THIRD EDITION—REVISED AND ENLARGED

COMPLETE IN ONE VOLUME

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PREFACE TO THE THIRD EDITION.

For some time there has been a demand for a third edition of this work but until the present it has been impossible for us to give the necessary attention to make the careful revision which seemed indicated. During the interval since the publication of the second edition we have collected material constantly for this new edition. We have also had ample opportunity to test many of the newer methods and to confirm many of the old ones as we have kept careful records of more than fifteen thousand operations performed by us in this period.

Our methods have been adopted from many surgeons and adapted to our conditions. In many instances these surgeons have kindly furnished personal information and illustrations for which we wish to express sincere gratitude, as also for the inspiration and encouragement experienced through contact with these enthusiastic and tireless workers in the field of surgery.

A. J. O.
N. M. P.

PREFACE TO THE SECOND EDITION.

In the preparation of the second edition the same general plan has been followed that was introduced in the first.

With increased experience in the use of operations which had not been fully tried, it has been possible to make some portions of the text more complete.

The additional material has, however, all been substantiated by my own clinical experience and can be depended upon in the same manner as the portion of the book which appeared originally.

In the chapter on stomach surgery an article by Dr. W. J. Mayo has been introduced in full because this covers the subject so perfectly that it would be impossible to improve upon it. I am again greatly indebted to this author for many valuable suggestions as well as for a number of most excellent original plates.

The text has been increased by about sixty pages, and the number of plates has been increased by nearly fifty per cent.

The views expressed concerning the treatment of certain forms of appendicitis, which differed materially from the generally accepted plan at the time of publication of the first edition, has been tried by hundreds of surgeons who have been able to follow the method carefully as described in this volume. Many of these have kindly informed me of the success they have obtained in this direction.

My own experience in the treatment of more than one thousand cases of appendicitis during the past three years has further confirmed the correctness of these views.

I wish to express my thanks to the many surgeons who have shown their appreciation of my efforts in the production of the first edition.

A. J. O.

PREFACE TO THE FIRST EDITION.

Many practitioners who have honored the author by visiting his clinic have requested that a work on Clinical Surgery be written by him, giving as nearly as possible the methods adopted in actual practice. This request has been met by the statement that the author lays no claim to the invention of a single new operation, nor has he produced a new or modified instrument, but has contented himself with applying to his surgical work what seemed best in the practice of the surgeons of the past and present, many times without knowing by whom the various methods were modified before they were accepted and used by him.

This book is therefore offered for what it is worth under the limitations mentioned, the author being conscious of a certain incompleteness because of adhering closely to the intention of producing a work reflecting almost entirely the methods which have been thoroughly tried in his own practice.

In recommending certain steps the author does not desire to impress the fact that the method chosen or advised is the best, or the only good one, but rather that it stands as a means he has thoroughly tried and which can be reasonably relied upon. Whenever there is any doubt upon this point it is expressly so stated in the text.

There are necessarily some branches of clinical surgery in which the author's experience is limited, and it has seemed best to indicate this in the text in discussing the special subjects thus impaired.

Certain operations can obviously have no place in this volume, because they have been described in a given way by many writers for years, and would simply consume space for reiteration without increasing the value of the work. I refer especially to the typical ligations, amputations and the resections of joints.

A portion of this work deals with clinical cases taken from hospital records and discussed as one discusses such cases in practice. This has been done for the purpose of bringing the actual clinical conditions before the mind of the reader. It did not seem wise to carry this plan through the subjects in which it was possible to bring out the salient points in more concentrated manner. In order to impress the reader with the cardinal facts upon which success in the treatment of various conditions depends, many unimportant and useless matters have been intentionally omitted. This undoubtedly reduces the scientific merit of the book, but it has appeared to the author to increase its practical value.

No reference is made to authors whose methods are described, because most of the procedures set forth were not used in their original form, having been repeatedly modified usually by a number of operators. In order to give each one the due amount of credit deserved the work would have grown far beyond the designed limits. An exception is made in those cases in which the original drawings of writers are employed. The author is indebted to all of his friends in the surgical profession whose methods he has adopted, and hopes that where they find familiar details they will appreciate the gratitude he bears toward them for having markedly assisted in the improvement of his technique.

All drawings herein are original, having been made by Miss Alice L. Cleaveland for this volume from immediate operations, with the exception of a few which were taken from original publications of other authors; the latter are especially designated in their accompanying text.

The author is particularly indebted to his friend, Dr. W. J. Mayo, for many valuable suggestions, and to his brother, Dr. E. H. Ochsner, and his chief assistant, Dr. Nelson M. Percy, for relieving him of many burdens incident to the production of a book.

Finally, it should be said that this work is not written for the great surgeon, or the teacher of surgery, whose methods are as well tried as those contained in this volume, and undoubtedly quite as useful, but rather for the man who is compelled, by virtue of the circumstances surrounding him, to do surgery, and who wishes to know what the author would do in a similar case to the one he happens to have under treatment at any given time. He may be familiar with many methods, but at the same time may wish to know which one has seemed most satisfactory to the author.

A. J. O.

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PART I.

GENERAL SURGICAL CONSIDERATIONS

EXAMINATION OF THE PATIENT

The benefits of clinical surgery cannot be realized to the fullest extent without considering the patient himself, aside from the disease for the cure of which he seeks surgical treatment.

Much of the surgeon's success depends upon the value of his judgment and knowledge outside of his especial line of work.

Many patients may live in relative comfort for a considerable period of time whose lives may be cut short by an attempt to obtain complete relief. On the other hand, many patients may, with the same degree of safety, obtain complete relief, rather than partial, as a result of the excellence of the surgeon's judgment.

Clinical Experience of the Surgeon.

To excel to the fullest extent, the surgeon requires not only the necessary knowledge to make the proper diagnosis, and technical skill to perform the necessary operation, but he must also have an extensive clinical experience, which can fortunately be obtained, in this country at least, in service as assistant to those who possess this experience, particularly in the great number of excellent hospitals which have been established in most of the larger cities.

General Examination of the Patient.

In order to be able to judge of the patient's condition, aside from the particular ailment from which he is suffering, it is necessary in each case to make a careful general examination. This should include a physical examination of the chest, the abdomen, the nervous system, the urine, and at least an observation of the character of the feces. In many cases the blood should be examined. If there is cough the sputum should be examined microscopically.

Diagnostic Section of Tumors Condemned.

In making an examination we should, however, be exceedingly careful not to fall into the opposite error of making a diagnosis without regard to the patient. We have repeatedly seen patients lose their lives because of the fact that the surgeon felt it his duty to make a positive diagnosis. This is especially true of cases in which portions of safely removable tumors were excised, previous to their total removal, for microscopic examination for the purpose of making a positive diagnosis. In these cases we have frequently seen metastases appear very soon after this apparently unimportant preliminary diagnostic operation was performed, which were probably due to the excision of the small portion. We believe this should be very strongly

condemned, because the removal of a benign tumor is in reality a harmless performance compared with the dissemination of a malignant growth. There are but few exceptions to this rule, chiefly in case of bone tumors in which the treatment of a malignant growth would necessitate an amputation, while a benign tumor can safely be removed from the implicated bone.

Diagnostic Palpation of Tumors Condemned.

In connection with the diagnosis of malignant tumors we would also caution, very emphatically, against applying much pressure to the surfaces of these growths. We have observed many cases of carcinoma of the breast, for instance, which had remained almost stationary for many months until the patient began to have it examined. Each successive examining physician and all the patient's friends had thoroughly massaged the growth during repeated examinations and it seems reasonable to suppose that in this way the rapid increase in growth, the involvement of the lymphatic glands, and possibly the metastasis in the liver could be explained, because of the likelihood of forcing cells from the primary growth into the lymph channels.

In the same manner, we have observed that patients suffering from septic infections of the extremities regularly show a rise in temperature after a thorough examination, during which every effort was made to locate points of fluctuation.

It seems reasonable, therefore, to condemn what might be called diagnostic massage, at least in all patients suffering from malignant growths and septic infections.

Exploring Syringe Condemned.

The exploring syringe is an instrument which is also responsible for much harm, because in many cases in which pus has been diagnosed positively without this instrument, the syringe, instead of confirming the diagnosis, shows negative results, on account of some obstruction in the lumen of the exploring cannula used.

In a number of instances we have seen great accumulations of gas removed from empyemata and other abscesses after repeated tests with the exploring syringe had resulted negatively. This is frequently the case, even when a needle with large caliber is used. Many an abscess has remained unopened because the exploring needle was supposed to afford a positive test.

In other cases extensive and serious infections have been caused by the use of the exploring syringe because the great pressure under which the pus was confined in the abscess has forced it into the surrounding tissues or cavities along the puncture made by the exploring needle.

In exploring the brain for the location of an abscess it is sometimes necessary to use an exploring syringe with a large cannula—it may also be useful in differentiating between pleurisy with effusion and empyema—but aside from this we believe that its use should be discarded.

All that has been said against the use of the exploring syringe can be said with much greater emphasis against an instrument which has fortunately been almost entirely discarded, namely, the grooved exploring needle. This instrument possesses all of the bad qualities of the exploring syringe to an exaggerated extent, without having any of its good qualities.

If it seems advisable to make use of an exploring syringe in a given case it should be armed with trocar of the desired size instead of the ordi-

nary aspirating needle, as the former is much less likely to be obstructed and is therefore more certain to give the desired information.

The Personal Element of Risk in Operations.

In considering the patient in relation to the advisability of an operation, it will be found that in a large majority of cases there is scarcely any doubt regarding his ability to bear the operation itself, barring accidents; but this fact should not lead us to take for granted that this will be the case in any individual case without having taken pains to make sure. With experience one learns to place certain cases in the class of good risks and others in the class of bad risks, with many intermediate grades; and it is not an easy matter to classify these cases so that one who has not actually come in contact with them can appreciate their difference even with a very minute description.

We would class among the good risks patients who are nearly normal as regards all the organs of the body, with the exception of the part involved in the disease for which the operation is to be performed; if the disease is not located within or near an important organ; and provided that the operation is not to be done for the relief of a disease due to an acute infection. If the operation is to be performed for the relief of an acute infection, then the risk will depend upon the question, -Can the progress of this infection surely be prohibited by the operation?

It seems that an acute infection does not respect natural strength or endurance. We have here, however, quite a safe guide in the condition of the pulse. An operation performed upon a patient with a pulse of over 120 beats per minute must always be looked upon as serious, and with a pulse still higher the gravity of the condition increases rapidly.

If the operation will remove the existing septic material and at the same time make a further infection impossible, or at least unlikely, then it must be looked upon as being relatively safe.

OLD AGE.

Old Age of Itself Not a Contraindication to Surgery.

Among the conditions almost always enumerated as contra-indicating serious operations is old age. There are certain very good reasons for this. A person who has lived many years has had relatively more opportunity to impair his various organs than one who has lived a shorter time. Moreover, his tissues are in themselves old, and especially his blood vessels have lost much of their elasticity. On the other hand, we must bear in mind that the fact that these persons have attained great age would indicate that they were primarily well made or that their normal resources have been well preserved.

As a matter of experience, we would state that in the absence of obesity, arterio-sclerosis, nephritis, marked anemia, or cachexia, due to the presence of malignant growths, patients advanced in years bear surgical operations well, if they are permitted to move about and sit up soon after the operation. (This allowance rarely interferes with the recovery after any operation, provided we bear this in mind in the suturing of the wound and in applying the dressings).

Confinement to be Avoided.

To one whose attention had not been directed to this peculiarity of

patients advanced in years it might seem foolhardy to permit the patient to sit up on the day following so serious an operation as amputation of the breast with removal of the pectoralis major and minor muscles and the axillary fat and lymph glands, but experience leads us to say that in operations as severe even as this one, the course mentioned is strongly to be advised.

Lowered Resistance from "High" Life.

There is one element which it is well to bear in mind in connection with the consideration of old age in surgery. Many times patients not much over forty years of age, whose lives since adolescence have been spent under conditions of severe mental tension, so common among business and professional men at the present time, show a degree of senility so far as their nervous and vascular systems are concerned, which indicates that they should be classed with those who are in reality from twenty to thirty years older. In these patients one encounters a high degree of arterial tension, an erratic, nervous heart, and there is usually a deficiency in the excretion of urea. This condition is much more common among men than among women, because men are more constantly exposed to nervous and mental strain than women, with the possible exception of the small and useless class known as "society" women, which is so unimportant as not to require attention save to point the contrast. This condition of instability is undoubtedly exaggerated by the poisonous effects of nicotine and alcohol, which serve so well as temporary stimulants in relieving the immediate distress of mental and nervous strain to which professional men and business men are exposed.

In these cases thorough elimination by the use of very little easily digestible food, the taking of large quantities of good water, the gradual reduction in the use of tobacco and abstinence from alcohol are strongly indicated.

Fresh buttermilk seems to be especially useful both as a food and as an eliminant in these cases. Castor oil given in two-ounce doses in the form of beer or ale or extract of malt aids greatly in improving the condition of this class of patients.

These patients should never be exposed to long continued operations, and they are especially bad subjects for nitrous oxide gas anesthesia, because of its effects in increasing the blood pressure.

The use of continuous proctolysis under low pressure or by the drop method following operation is especially valuable in this class of cases because by favoring elimination this method greatly relieves the circulatory system.

Many cases do badly after operations without showing definite symptoms of sepsis or complications pointing to disease of the kidneys, heart or lungs, although all of these organs may be under suspicion. There may be too small an amount of urine secreted suggesting the likelihood of acute renal congestion, causing a fear of impending uremia, or the heart's action may be somewhat erratic or weak causing one to fear that a myocarditis may have been overlooked. Again, there may be accelerated respiration indicating the possibility of an incipient pneumonia, or these conditions may exist simultaneously with or without beginning sepsis.

In our own experience it has seemed as though one can usually anticipate this condition by a careful preliminary examination, together with a

careful consideration of the patient's history, and especially that part of the history which relates to the habits of life, especially as regards nervous strain and rest and the use of alcohol, tobacco and drugs; also the consideration of the quantity and quality of food accustomed to.

On the other hand the patient can often be protected from danger by a preliminary course of hygienic living especially where there is no great urgency, and the operation is for chronic conditions.

Laxatives Before Operations.

We have used various forms of cathartics previous to operations at different times, but have now come to depend on but one cathartic before operation in all cases in which there is present no form of peritonitis or intestinal obstruction. In the latter classes of cases any form of cathartics or laxatives should be condemned most vigorously. In all other cases two ounces of castor oil is given to adult patients, one-half this dose to children from four to twelve years of age, and proportionately less to younger children and infants.

High Blood Pressure.

The matter of abnormally or excessively high blood pressure does not have to be considered in patients less than thirty five years of age and only in rare instances in patients less than fifty-five years of age. It should, however, be borne in mind that it is in fairly young patients that one is most likely to get into difficulties from this cause, because it is much easier to overlook this source of danger in the relatively young patient than in those more advanced in years.

Many of these patients will bear an operation which involves only a small amount of trauma without any difficulty, while they succumb to extensive operations in which they are subjected to the influence of anesthetics for a considerable period of time. In such cases the nervous strain accompanying local anesthesia is also borne very badly, consequently, there is not much choice between these two evils. It is, however, often possible to perform these operations in two or more stages. If such a patient for instance, has a tumor and gall stones, or a hernia and some other pathological condition, or any two of any number of other combinations, it is best to perform one of these operations at a time. In intracranial affections, for instance it is better to make a temporary skin and bone flap, control the hemorrhage carefully replace the flaps and complete the operation when the patient's condition has been thoroughly restored.

It is not necessary to go into details at this point, the general principle involved simply contemplates a plan by which as small a burden as possible is placed upon a patient who is not in a good condition to carry additional burdens. These patients usually bear repeated light burdens better than single heavy ones.

INFANCY.

Infants Bear Operations Well.

The same seems to be true of the other extreme in age. Infants bear operations well, provided they are not too long continued, nor are they killed by too great loss of blood.

Guard Against Hemorrhage.

The mortality in infants following operations is due largely to hemorrhage.

caused by the trauma of the operation and hemorrhage. It is important to remember that an amount of trauma which would not have to be considered in adults because of the size of the patient and the consistency of the tissues, may result in serious shock in infants and young children. Again, the same amount of blood lost in a child weighing fifteen pounds is ten times as serious as the same amount lost in an adult weighing one hundred and fifty pounds.

Operate Rapidly.

A surgeon who is slow but violent in his manipulations should therefore choose only adult patients. Operations upon infants should be carefully planned, quickly executed, and with the least possible amount of trauma and smallest possible loss of blood.

Quite a few children and infants die after operation from pneumonia. This can, however, be almost completely eliminated by reducing the time of operation to a minimum and permitting the child to almost completely come out of the anesthesia by the time the operation is finished and by applying the sutures so that the patient can move about freely and if possible to sit up in bed soon after the operation has been terminated.

Protection of the Mother in the After-Care.

In nurslings it is moreover most important to secure the co-operation of the mother. The latter should never be permitted to undertake the care of the infant after a serious operation, because the resulting fatigue and anxiety will surely have a harmful effect upon the milk, and the child will consequently suffer from gastric disturbances in addition to those naturally resulting from the effects of the operation.

These conditions should be carefully explained to the mother so that her natural anxiety for the safety of her child will serve to improve its prognosis rather than to reduce its chances. In many instances we have seen a worn-out mother improve remarkably in health during the time her child has been confined to the hospital, and with the improvement of her general condition the child's nutrition is always greatly improved. The mother should not live in the hospital but conveniently near so that she can come to the hospital at regular intervals, varying from three to four hours, according to the age and condition of the child.

It is well for the mother to have a definite program which she must follow absolutely. She should never be permitted to carry or hold the child except while actually nursing it. Before she nurses the child the first time in the morning she should drink a pint of hot milk or gruel so that she will not be in a depressed condition during the act of nursing. After nursing the child she may take a walk in the open air, then breakfast liberally, then rest for at least one hour and return to the child just in time for the next feeding. Her luncheon is again followed by a period of rest. In the middle of the afternoon the mother may take some nourishment, preferably a pint of milk, with bread. She may take a liberal meal in the evening, nursing the child at regular intervals varying from two to four hours according to the requirements of the little patient, the time of nursing being so arranged that the mother can obtain from seven to ten hours of uninterrupted sleep. She should always take some nourishment before retiring. Both the mother and the child will form regular habits during the time the latter is in the hospital and the health of the former, and the nutrition of the latter invariably improve to a marked extent.

LOSS OF BLOOD.

Importance of Safeguarding Blood Supply.

For all patients it is wise to guard against the loss of an unnecessary amount of blood; but this is especially true in children and in those advanced in years, because many of these do not recover readily from an anemia caused by a great exsanguination. Every operation should be carefully planned with the idea of preventing the unnecessary loss of blood. Usually this end can be accomplished if the surgeon lays out a thoroughly systematic course for his operation, because the source of hemorrhage in every operation can be anticipated by applying two pair of forceps to each one of the larger vessels before it is severed and quickly applying clamps to the oozing surfaces as the operation progresses in all parts of the body in which it is not possible to entirely prevent hemorrhage during operation by the application of elastic constriction. If the surgeon has assistants who have learned how to concentrate their attention during the progress of the work, much is gained in saving blood because they will anticipate the surgeon and will stop all hemorrhage almost instantly in those points in which one cannot apply forceps before severing the tissues.

Slow vs. Rapid Operating.

There are two errors which will be referred to again presently which the surgeon should not fall into in his attempts to prevent loss of blood, namely; too rapid and too slow operation. The former is certain to lead to calamity occasionally in individual cases, although the majority of patients will undoubtedly do well under very rapid technique. The slow operation is especially likely to result in secondary trouble like pneumonia and nephritis.

It is important to take a reasonable attitude regarding this feature. It is possible to be guilty of insane haste on the one side and of imbecile deliberation on the other.

OBESITY.

Special Care Required.

Patients who are very obese, especially those beyond middle age, require particular consideration. Their resistance is diminished; they recover from shock less speedily; they frequently take the anesthetic badly, and they are more liable to pneumonia following the use of ether than patients with a normal amount of fat. Still it is only seldom that the presence of obesity will contra-indicate an operation entirely. Ordinarily it would simply indicate the use of especial care.

In many of these patients it is possible to reduce the weight to a great extent before operation by following a systematic plan of dieting, combined with exercise and baths to be described presently.

In planning the operation in these cases the wound should be so sutured that they can move about freely in bed and if possible sit up directly after the operation, especially for the purpose of preventing hypostatic pulmonary congestion following operation.

TUBERCULOSIS.

General Operations Inadvisable.

In patients suffering from tuberculosis an operation is usually borne

well if it removes the tubercular tissue. If this is not removed by the operation such patients frequently do not do well, consequently the presence of tuberculosis is only a contra-indication to operation in a limited variety of cases.

In patients suffering from pulmonary tuberculosis long-continued operations are contra-indicated chiefly because the disease in the lungs is likely to make progress during the time that the patient is recovering from the depressing effects of the operation.

It is difficult to say whether ether anesthesia is really in itself harmful in these cases. It has been suggested that anesthesia by inhalation be not employed in such instances and that local, spinal or rectal anesthesia be substituted in all cases in which pulmonary tuberculosis is present.

Preliminary General Treatment.

It is generally possible to place these patients under preliminary hygienic, diatetic and often under climatic treatment for the cure of the pulmonary tuberculosis before they are subjected to surgical operations. In many the local condition, if it is also due to tuberculosis without mixed infection, will recover simultaneously with the pulmonary tuberculosis. This is true especially in cases suffering from joint tuberculosis in which perfect immobilization has been accomplished while the pulmonary condition is under the above form of treatment.

CACHEXIA DUE TO MALIGNANT GROWTHS.

A Contraindication.

Ordinarily the presence of cachexia in patients suffering from malignant growths is a distinct contra-indication to operation because these patients do not bear operations well and with few exceptions derive very little benefit therefrom. This is, however, not the case in ulcerating carcinoma in which the cachexia is due largely to the absorption of products of decomposition, which can often be safely eliminated by an operation.

Again, in cases in which the malignant growth interferes with nutrition by obstructing some portion of the alimentary canal this rule does not always hold good, because frequently the improved nutrition greatly overbalances the traumatism resulting from the operation.

In a general way it may be stated that so long as the condition in a given case seems to indicate the possibility of removal of all of the malignant tissue the operation is warranted provided it does not necessitate the removal of a part of the body which is necessary for the continuance of life. In some cases the apparent cachexia can be removed before operation by appropriate treatment.

Example: Gastric Carcinoma.

In cases of carcinoma of the stomach, for instance, the patient frequently absorbs a quantity of decomposing substance during a considerable period of time, and as a result of this his condition becomes markedly cachectic. In many such the tumor may still be confined to the stomach. If operated at once the resistance of the patient may be so low on account of the condition described above that he may succumb to the shock of the operation. If the same patient has gastric lavage performed three times daily at intervals of eight hours, or four times daily at intervals of six

hours, two hours after receiving some concentrated sterile food, his condition will improve to a surprising extent in from one to two weeks.

The ingestion of small doses of oil of eucalyptus, from five to twenty drops after each gastric lavage, is of further aid in the disinfection of the stomach cavity. In the meantime the patient's strength can be further supported by giving rectal feeding in the form of one ounce of the various concentrated liquid predigested foods in the market dissolved in three ounces of normal salt solution, administered slowly as an enema through a small rubber catheter introduced into the rectum for a distance of not more than three inches.

One Danger in Preliminary Treatment.

One danger must be borne in mind in connection with this form of preliminary treatment. In many instances the general welfare improves to so marked an extent that some doubt may arise concerning the original diagnosis, and this may give rise to postponement of the operation until the carcinoma has advanced to a hopeless point. It is always bad practice to postpone operations of any kind in patients suffering from malignant growths, because after such a growth has once begun to invade the surrounding tissues there is no stopping in its progress except by its complete removal or by the death of the patient, hence the importance of not losing valuable time before an attempt is made to remove the growth.

SPEEDINESS IN OPERATING.

Two Viewpoints.

The question of time is of sufficient importance to demand some consideration. It is only necessary to look upon an operation from the two sides which have a bearing in order to come to a proper estimation of the importance of this element: 1, from the merely mechanical or technical point of view, and, 2, from the point of applying this to the patient.

From the technical standpoint it is plain that a skilled mechanic not only does his work well, but accomplishes it in a relatively short time, while an unskilled mechanic will have much less satisfactory results by taking a much longer time; skill, accuracy and facility naturally going hand in hand in bringing about the highest possible outcome.

Careful Haste.

However, a hasty mechanic may complete a badly-constructed product in a relatively short period of time, and it is consequently necessary, from a purely technical standpoint, to distinguish clearly between speed which is the result of skill and dexterity, and speed resulting from carelessness, wanton haste and lack of thoroughness. From a strictly technical standpoint, then, we have a right to demand the greatest speed compatible with careful, thorough work. When we come to apply this directly to the patient still further elements will be introduced.

Hasty and careless work is more harmful because of the needless traumatism which it is likely to produce, and this may in turn result in shock or in the injury of structures needlessly implicated. The patient may not receive the full amount of benefit through lack of thoroughness, some conditions being overlooked and neglected on account of undue haste.

years to give less and less attention to details in the general planning and management of the work, nothing is so certain to displace the older members of the surgical profession as a tendency to make a less thorough diagnosis as the years accumulate.

On the other hand nothing can be of greater importance in the development of the younger surgeon than an opportunity to make a large number of careful, systematic, clinical examinations in cases which have been or are to be carefully examined by a surgeon of vast experience and to be compelled to make an independent diagnosis in these cases.

SPECIAL METHODS OF EXAMINATION.

During the past few years a number of methods have been developed for the examination of patients by the use of various vaccines and by variously prepared blood sera.

In the diagnosis of tuberculosis, syphilis, carcinoma and sarcoma much valuable work has been done. Many of these methods are undergoing such rapid changes that it will not be wise to describe them here, because better methods than any now in use will undoubtedly be advanced in the current literature before many months. It should be stated, however, that all of these procedures are worthy of much attention and should be considered at least when they confirm a diagnosis made by means of old methods of examination.

TESTS FOR TUBERCULOSIS.

In suspected cases of tuberculosis in which no infective material can be obtained for demonstration of tubercle bacilli tests are of great value

Tuberculin.

1. *Temperature test.* Koch's old tuberculin which has been carefully standardized by comparison with tuberculin of a known strength, should be used. If the tuberculin is prepared according to Koch's methods and standardized by Ott's method, a normal person will not show a reaction with a dose of .010 c.c. of the original tuberculin. For an adult .0005 c.c. is a safe initial dose. It is best, however, to give at first either .0001 or .0002 c.c. If these do not produce a reaction the following doses should be given—.001 c.c., .003 c.c., .005 c.c., and .008 c.c., or even .01 c.c.

In considering the dose to give, it is necessary to take into consideration the age, sex, physical condition, together with the duration and extent of the disease. In children .0001 c.c. is a safe initial and .003 c.c. a safe maximal dose.

Technique of Tuberculin Injection.

Before use, the tuberculin must be diluted, which is best done by the physician. A pipette graduated to hundredths of a c.cm., and a graduated cylinder, are necessary to make the proper dilution. A solution of 25 per cent phenol in physiological salt solution is the best diluent. If the salt solution is used alone it must be prepared before each injection. The hypodermic syringe, needles, pipettes, cylinders, etc. should be carefully sterilized. The skin should be thoroughly cleansed with 95 per cent alcohol before and after the injection. The injection is best made into the deep muscles of the back rather than subcutaneously. A sterile pad is then placed over the point of injection and allowed to remain at least twenty-four hours.

Reaction.

There is a rise of temperature 1—2 degrees about eighteen to twenty-four hours after the injection. It is necessary to take the temperature for two or three days before and after the injection.

Contraindications.

The method should never be employed in cases in which a positive diagnosis can be made without, because it is in this class of cases that one sometimes causes violent reactions which may have a depressing effect upon the patient.

It should not be used when the patient is temporarily below his usual condition, or when he is suffering from any acute disturbance, especially if this is accompanied by an elevation of temperature.

One minim of tuberculin used as indicated is mixed with one ounce of a one-half per cent carbolic acid solution. Ten drops of this solution is equivalent to one-tenth of one milligram of tuberculin.

Rotch and Floyd Method.

Rotch and Floyd's method of preparing the tuberculin. One c.c. of Koch's old tuberculin is added to 999 c.c. of boiled distilled water; 1 c.c. of this solution equals 1 milligram. The dose of this solution for an infant or child is from 2 to 5 milligrams, according to the age. Moeller, with his large experience, formulates the following rules for the use of tuberculin in the diagnosis of tuberculosis, after noting contraindications for its employment, such as fever, hysteria, recent hemoptysis and epilepsy. He begins usually with .1 to .2 milligrams, obtaining this quantity by dilution as follows:

(a)

1 c.c. of tuberculin + 9.9 c.c. of .5 per cent. carbolic acid—1 c.c. of this = .01 gram tuberculin.

(b)

1 c.c. of (a) dilution and 9 c.c. of .5 per cent. carbolic acid—1 c.c. of this = .001 gram tuberculin.

(c)

1 c.c. of (b) + 9 c.c. of .5 per cent. carbolic acid—1 c.c. = .1 mmgm. of tuberculin.

(d)

1 c.c. of (b) + 4 c.c. of .5 per cent. carbolic acid—1 c.c. = .2 mmgm. tuberculin.

(e)

1 c.c. of (b) + 2 c.c. of .5 per cent. carbolic acid—1 c.c. = 0.3 mmgm. tuberculin.

TUBERCULIN INOCULATION, OR VON PIRQUET'S TEST.

About two drops of diluted tuberculin (old) is placed on the skin and a small scarification is made with a sterile lancet through the drop.

Method.

In this particular method make a 25 per cent. solution of old tuberculin in salt solution. A similar dilution is used in which one volume of a 5

per cent. solution of carbolic acid in glycerin is substituted for one of the volumes of salt solution. Place two drops, one of each solution separated from each other by a space of two inches, on the outside of the arm, which should be prepared as is customary for vaccination. A small lancet with a dull tip which is about one-sixteenth of an inch wide and placed vertically in a metal handle is used to abrade the skin through the vaccine drops by a rotary motion, removing only the upper layers of epidermis. The tip is then cleaned and at a point midway between the vaccination marks a third abrasion is made without any tuberculin being applied to serve as a control.

If the reaction is positive a papule varying in size from 5 to 20 mm. in diameter, at first bright-red, later becoming a dark-red with a slight areola, will appear at either vaccination point in the first twenty-four hours, occasionally this does not appear until forty-eight hours.

TECHNIQUE FOR MICROSCOPICAL EXAMINATION OF BLOOD.

Obtaining the Blood from the Patient.

For microscopical examination the blood is preferably obtained from the lobe of the ear, which is cleansed thoroughly with alcohol on a sponge, it is then wiped dry with sterile cotton, rubbing rather vigorously so as to produce a slight hyperemia. The style of needle to be used is of little importance. It should be kept immersed in alcohol when not in use. The point of the needle is inserted into the inferior surface of the most dependent part of the lobe, far enough to cause the blood drop to form without using pressure. The first drop is wiped away. The next drop is employed to determine the hemoglobin. For this purpose the Tallquist hemoglobin scale is used. A bit of the paper from the book (which accompanies scale) is held in apposition with the freshly formed droplet. This is allowed to dry (which requires but a moment) and the color is then matched according to the scale. This is accurate enough for all practical purposes.

The Thoma-Zeiss Apparatus.

The next step is to fill the red blood counter pipette. The Thoma-Zeiss apparatus is here used. A fresh drop is allowed to form; the tip of the pipette is placed against the drop (never touching the ear) the blood is sucked up to the mark 0.5 (precision is essential), the tip is wiped off and the pipette is plunged into normal NaCl solution; the pipette is filled with this up to the mark 101 and then twirled about so that the salt solution and blood become intimately mixed. By this procedure hemolysis and crenation are prevented and the blood is diluted 200 times. The next step is to fill the leucocyte counter. A fresh drop is allowed to form—the leucocyte pipette is filled with blood to the mark 0.5 and the tip is cleansed and the pipette is then filled to the mark 11 with 3 per cent. acetic acid. The acetic acid dissolves the hemoglobin out of the red cells. A slight inaccuracy in filling this pipette will cause a great error in the final result. The dilution is 1—20 in the pipette. For making a differential count, a drop of blood is allowed to fall on the end of a glass slide. The slide must be absolutely clean and free from fat, etc. The drop should be a small one. It is spread according to the diagram.

A bit of cotton is placed against the patient's ear to catch a drop or two which may ooze out. The blood is now ready for microscopic examination. The Thoma-Zeiss chamber is used.

Counting Erythrocytes.

The pipette is then twirled again so as to make certain that there is a uniform distribution of the corpuscles and a few drops are blown out (the part which has not been in the bulb contains mostly salt solution and few corpuscles). A drop is then placed on the platform of the counter and is covered with one of the specially ground glasses which go with the instrument. This step requires care. There must be no air bubbles; the entire platform should be covered and none of the liquids should run into the moat. If these requirements are not fulfilled, remove the cover-glass, clean the chamber and use a new drop. When the satisfactory drop is obtained, allow the corpuscles to settle and examine with the low power of the microscope. Be sure that the corpuscles are evenly distributed.

The following is a quick and fairly accurate method of determining the number of erythrocytes. Altogether 80 (5x16) small squares are counted. To the total number of cells counted four ciphers are added and the result gives the number of cells in a cubic mm. In counting little squares, all the cells touching the right hand and upper boundaries of the square are included in count.

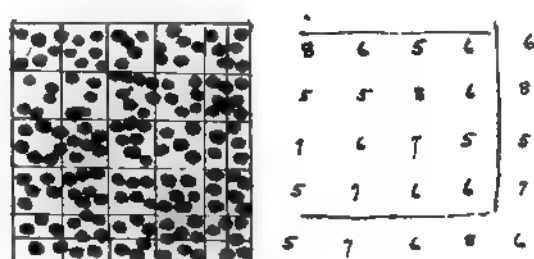


Fig. 1.

Counting the Leucocytes.

The drop is prepared according to the same procedure, the same precautions being used. The cells in the entire field of 400 squares are counted. The drop is wiped off and the slide cleaned and this performance repeated. Three drops altogether are counted. The difference between the counts of the various drops should not exceed 8 at the utmost. If there is a greater discrepancy, faulty technique is to blame. Determine the leucocyte count thus:

Drop A—42.

Drop B—42.

Drop C—46.

Sum 130 divided by 3 gives an average of 43.33. This multiplied by 200 equals 8,666, the number of leucocytes in a cu. m.

Differential Count.

Wright's stain may be used but is only good when fresh.

A very satisfactory method is to use Jenner's stain and methylene blue. The blood film is allowed to dry in the air. Jenner's stain is dropped on the slide and allowed to act for two minutes. This is then washed off and Loeffler's blue is allowed to act for two minutes. (If Jenner's stain is fresh and of full strength this step is superfluous). This is then washed off and the smear is allowed to dry in the air. It is now ready for examination. A drop of cedar oil is dropped on the slide and the smear is examined with the oil immersion lens.

Composition of Jenner's Stain.

Jenner's stain is made as follows: Equal parts of a 1.2 per cent. aqueous solution of eosin and a 1 per cent. aqueous solution of methylene blue are mixed in an open dish and allowed to stand for 24 hours. The resulting precipitate—the eosinate of methylene blue—is washed with water, collected on a filter, dried at a moderate temperature, and finely powdered. The dye can then be stored in bottles and is perfectly stable. For staining purposes a 0.5 per cent. solution in absolute methyl alcohol is employed; this can be used at once and keeps indefinitely. In preparing the dye first weigh out requisite amount of eosin and methylene blue. The eosin is placed in a mortar or evaporating dish and rubbed into a paste with a small amount of water; more water is then added until all the dye is well dissolved. This solution is poured into a large saucepan and diluted to the proper point. The methylene blue is now similarly brought into solution, though with a little more difficulty as the dye is inclined to be lumpy; it must all be dissolved. This solution is poured directly into the eosin solution and the requisite amount further added. The mixture is stirred with a rod and left to stand. If the proper quantities have been used and well dissolved, the filtrate is but little colored, in which case not much washing is necessary; if, however, there is a distinct excess of either dye, and notably the methylene blue, this must be washed out, which is best done by decantation. The alcoholic solution finally is prepared by rubbing up the dye with the alcohol in a porcelain dish. Absolute methyl alcohol must be used.

The red corpuscles are stained a terra cotta, the nuclei of leucocytes and nucleated red cells blue, the plaques mauve, the neutrophilic granules a purplish red, the eosinophilic granules bright red, and the mast-cell granules dark violet. Granular degeneration and polychromasia of the red cells is well shown. Malarial organisms, bacteria and filariæ are stained blue.

Differential Count.

For this purpose the carefully stained specimen is used. The oil immersion lens is used and the slide is moved about by means of a mechanical stage. For ordinary purposes a count of a hundred white cells suffices. If the relative percentages of the various kinds of white cells differ from the normal for the sake of accuracy it is well to count between 300 and 500. As the cells are counted they are accorded as shown.

A most important point is to use absolutely *clean, dry* apparatus. The pipettes after using may be cleaned by sucking into them, in order, water, alcohol and ether. In case a clot forms in the pipette nitric acid may be sucked up, but especial care must be used to clean the pipette thoroughly afterwards in the manner described as a slight trace of nitric acid in the pipette coagulates the blood.

The color index is obtained by dividing the percentage of hemoglobin

by the percentage of red cells, counting 5,000,000 as 100 per cent. Thus in a given case, e. g., the hemoglobin is 80 per cent. the red cells 4,200,000 (84 per cent.)

$$\frac{4,200,000}{5,000,000} \times 100 = 84. \quad \text{The color index} = \frac{80}{84} .95.$$

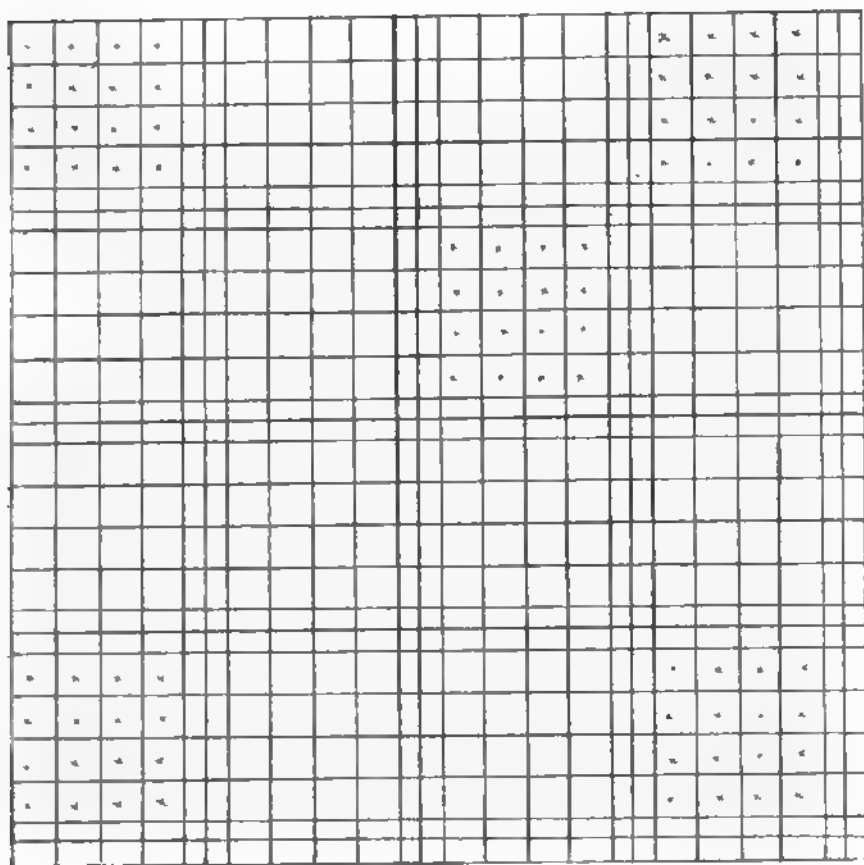


Fig. 2.

SPECIFIC GRAVITY OF THE BLOOD.

Clinically the determination of the sp. gr. adds nothing of significance to the facts learned by the microscopical examination and the hemoglobin test.

Hammerschlag's Method.

A clear glass cylinder, measuring about ten centimeters in height, is partly filled with a mixture of chloroform (sp. gr., 1.526) and benzol (sp. gr., 0.889) having a sp. gr. of 1.050 to 1.060. Into this solution

a drop of blood is allowed to fall from the ear, care being taken that it does not drop against the side of the vessel. If the drop sinks to the bottom, chloroform is added drop by drop and the mixture is stirred. If the drop tends towards the surface it is best to add an amount of benzol sufficient to cause the blood to sink and then bring it to the proper degree of suspension by adding chloroform. As soon as the drop remains suspended the mixture is filtered and its sp. gr. taken with an aerometer. The figure obtained is the sp. gr. of the blood. The chloroform-benzol mixture keeps indefinitely.

Coagulability is determined by means of one of the various coagulometers of which Wright's is the best. The blood is allowed to stand in tubes which are part of the apparatus and these tubes are successively examined at intervals of a half-minute until clotting has taken place, and the time that the blood has stood until the formation of the first coagulum is recorded.

Widal test is an aid in the diagnosis of typhoid fever.

TECHNIQUE OF STOMACH CONTENTS EXAMINATION.

Test Meal.

The stomach tube is passed and the stomach is thoroughly washed out with lukewarm, sterile water. The stomach tube is then removed and the patient given a test meal, consisting of two dry crackers and eight ounces of tea, without sugar or cream, which is removed after one hour by means of the stomach tube.

The Stomach Tube.

The stomach tube used is made of a not too soft grade of rubber. The tube is about 70 to 75 cm. long and has several apertures at the end which enters the stomach. A mark is placed about 40 cm. from the end as a guide as to how far the tube is to be introduced. For gastric lavage a rubber or glass funnel is attached to the proximal end. The tube is boiled in water before using and is cleansed in hot water after using. (It is best to have separate tubes for tubercular, leucic and carcinomatous cases.)

A great many contra-indications to the use of a stomach tube have been mentioned, the chief of which is recent hemorrhage from the stomach. In nearly all other conditions, except possibly in advanced aneurism, the passing of the tube, with moderate care, is fraught with little danger.

Technique of Tube Introduction.

The technique of passing the tube is simple. The patient is asked to sit up, the back is firmly supported, the clothing is protected by a rubber bib and sheets. The tube may be dipped in glycerine, or butter may be used for a lubricant. The tube is passed to the posterior wall of the pharynx; the head of the patient is bent forward slightly; the index finger of the left hand may be used to guide the tube into the esophagus. The patient is asked to take a deep breath and then a swallow. This is continued, the tube being pushed gently with each act of deglutition, until (watching the mark) the tube is seen to be in the stomach. At no time and under no conditions should any force be used. If the patient becomes cyanotic or faint the tube is to be instantly withdrawn.

If the gastric juice does not flow the patient is asked to cough and the tube is alternately withdrawn slightly and introduced (the end is never

drawn out of the stomach). Usually the juice will flow after slightly maneuvering. A Boas bulb or any suction apparatus (syringe, etc.) may be used to aspirate the fluid. Always allow the free end of the tube to hang well down, so as to facilitate the flow. If no contents are obtained after prolonged efforts, introduction of a couple of ounces of water will sometimes start the flow as the tube may have been clogged, and if this water returns clear it serves as evidence that the stomach is empty.

The tube should not be withdrawn too rapidly.

Chemical Tests for Gastric Juice.

The reaction is tested with blue and red litmus paper. Acid turns blue litmus red and red litmus turns blue in an alkaline medium. Congo red paper may be used to ascertain whether free HCl is present (red turns to deep blue).

The quantity, the appearance, the color and the odor are noted and tentative conclusions are arrived at.

The stomach contents are filtered, the filtrate being used for chemical analysis, the residue for microscopic examination.

The total acidity is first determined as follows:

Ten cc. of gastric juice are titrated with a decinormal solution of sodium hydroxide (made by dissolving 4 gms. of NaOH in a liter of water) 1 to 2 drops of an alcoholic solution of phenolphthalein being used as an indicator until the red color which appears after the addition of each drop of NaOH solution no longer disappears upon stirring. The number of cc. of NaOH used is then carefully read off. The acidity may be expressed in one of two ways, either in "acidity per cent." or "degrees," or in actual percentage. The former being the simpler is now more commonly used; the number of cc. is multiplied by ten (since only ten cc. were used and "degrees" expresses the acidity for 100 cc.) the result is the number of degrees of total acidity.

(Ex. 10 cc. of gastric juice required 5.8 cc. of decinormal NaOH to neutralize; the total acidity is 5.8×10 , or 58 degrees.)

To find the total acidity in actual percentage, take the number of cc. used (in above case) 5.8 and multiply $\times 0.00365 = .0212$ —this gives the acidity in 10 cc. So $.0212 \times 10$ or .212 equals the percentage of total acids in the gastric juice. Expressed in degrees the normal total acidity is between 45 and 65.

Free HCl (Toepfer test) 0.5 per cent. alcoholic solution of dimethyl-amidoazobenzol is used. Two drops are added to 1 cc. of gastric contents (need not be filtered); in the presence of free HCl a beautiful cherry red color develops, the color being more intense the more free acid is present. If no free acid is present, a yellow turbid color results.

Guenzberg test—A solution is employed consisting of 2 gms. of phloroglucin, 1 gm. vanillin and 30 cc. of absolute alcohol. This decomposes rapidly and should therefore be kept in a dark glass bottle. A few drops of filtered gastric juice and an equal quantity of the reagent are warmed (not boiled) together in a porcelain evaporating dish. In the presence of free HCl a series of rose (not brownish) lines develop around the edge. This is a positive test for free HCl, not as delicate as Toepfer's and more complicated. It is more accurate to dissolve 4 gms. of NaOH in less than a thousand cc. and bring the solution to the proper strength by titrating it against a solution of oxalic acid of standard strength.

Quantitative Determination of Free HCl.—Ten. cc. of filtered gastric juice are titrated (as for total acidity) with decinormal NaOH solution, using 2 to 3 gtts. of 0.5 per cent alcoholic solution of dimethylamidoazobenzol as an indicator. NaOH solution is added drop by drop and the gastric juice stirred, until the red color has entirely disappeared. The reading is determined and calculations made precisely as described for total acidity.

If the amount of contents removed is small, 10 cc. can be made to do for both titrations. The titration for free acid is first made with dimethylamidoazobenzol as just described and the reading taken; then phenolphthalein is added and titration continued until the gastric juice assumes a pink hue. The sum of the two titrations gives the total acidity. Normal 25 to 50 degrees.

The combined acids may be determined by using alizarin as an indicator and titrating with decinormal NaOH solution until a violet color is obtained. The practical value of this performance is very doubtful.

Among the above tests the presence or absence of free HCl is the most important; more so than the percentage of total acids or free acids. In the presence of HCl, organic acids may be disregarded. Pepsin, too, may be omitted, for it is always present when free HCl is present.

Pepsin and Pepsinogen.—If free HCl is present in gastric juice, to test for pepsin is superfluous. Should free HCl, however, be absent and it is desired to know whether pepsin be present or not, proceed as follows: To 25 cc. of filtered gastric juice add 3 to 5 gtts. of HCl. Then 0.05 gms. of egg albumin is added and this is kept at a temperature of 37 to 40 degrees C. The egg albumin should be digested within three hours.

The simplest but not quite the most accurate method of determining the quantity of pepsin is by the Hammerschlag method. He used a 1 per cent. solution of albumin with 0.4 per cent. free HCl which he put into two tubes, 10 cc. in each. To A is added 5 per cent. of water; to B, 5 cc. of gastric juice. These are left in a thermostat for about two hours. The albumin in each is then tested with Esbach's reagent in an Esbach tube.

Rennet may be tested for by Riegel's method, 5-10 cc. of gastric juice neutralized with decinormal NaOH and 5-10 cc. of fresh milk. This mixture is placed in a thermostat. Normally this will coagulate in from 10 to 15 minutes. Lactic acid must be excluded and the reaction should be unchanged by the ferment.

Lactic Acid.—Lactic acid is seldom found if the stomach has been washed out and a test meal given and removed after one hour, for lactic acid is not formed in this length of time. It is well to test for it in the fasting stomach. In all cases it is well to exclude possibility of lactic acid having been ingested.

The best test for lactic acid is Ueffelmann's. Always make reagent fresh. To about 20 cc. of 1 per cent. acid in a test tube is added 1 drop of 10 per cent. ferric-chloride. A deep amethyst color results. This is diluted with water until the solution is pale amethyst. Divide into two equal parts. To one part add a drop of distilled water (as a control); to the other, add a drop of gastric juice. If lactic acid is present, the first fluid turns yellow-green, or "canary" color.

Fatty acids do not normally occur, unless much milk or carbohydrate food has been ingested. Often they are found in connection with lactic acid, e. g., in carcinoma cases. The most frequent are butyric and acetic. They can usually be detected, if present in any quantity, by the sense of

smell. The simplest is the "pineapple" test. 10 cc. of filtered gastric juice are extracted with 50 cc. of ether. Ether is evaporated—a little sulphuric acid and alcohol is added to the residue. Butyl ethylate is formed which smells like pineapple.

Acetic acid may be detected by the odor or by extracting 10 cc. of gastric juice (filtered) with ether. Evaporate; the residue is dissolved in a few drops of water and accurately neutralized with a dilute solution of NaOH. Sodium acetate is in this way formed. To this a drop or two of dilute ferric chloride is added. A dark red color indicates presence of acetic acid.

With silver nitrate a precipitate is obtained which dissolves in hot water.

Mucus may be seen, when present in any quantity, with the naked eye. If equal parts of lime water and diluted acetic acid be shaken up with 5 cc. of gastric juice, a gelatinous cloud forms if mucus be present.

Bile is tested for, by Gmelin's test. A few cc. of fuming nitric acid is poured into a test tube and about 10 drops of filtered gastric juice are superimposed. In presence of bile a play of color is seen (on standing) at or slightly above the line of contact.

The presence of blood, as of bile, may be suspected by the color of the contents. Deen's test is reliable. To the gastric juice is added 1 cc. of fresh tincture of guaiac and 1 cc. of Huehnerfeld's solution (glacial acetic acid, 1, distilled water, 1, oil of turpentine, 100 and alcohol, 100). This mixture is shaken. If blood is present the fluid turns blue. (Certain iron compounds and some vegetables, etc., also give this reaction, so it is chiefly of negative value.

Microscopical Examination.—Slides are prepared from the residue of the gastric juice. They should not be too thickly spread. They may be stained with methylene blue or any of the ordinary stains. Examination should be made especially for Oppler-Boas bacilli, sarcinæ ventriculi, and fragments of mucous membrane or neoplasms, blood or pus. Tubercle bacilli should be looked for in suspicious cases after staining by the usual Ziehl-Gabbet method.

Ziehl's solution—Carbol fuchsin: Saturated alcoholic solution of fuchsin, 10 cc.; 5 per cent. carbolic acid water, 90 cc.

Gabet's methylene-blue—Methylene blue, 2; sulphuric acid, 25; water, 75.

GENERAL PREPARATIONS.

In this systematic examination many things are considered which may not have any bearing upon any given case in question, but when applied to all the cases in practice each point is of more or less importance.

Of course, the systematic analysis of cases must not be supposed to render superfluous the judgment and practical experience of the surgeon or physician who makes the examination. A thorough system, good judgment, and a wide experience will result in the accomplishment of benefit to the patient when employed simultaneously.

After all of the circumstances present in the case have been determined the necessary preparations for the operation may proceed.

Concomitant Diseases.

If there exists serious disease of one of the important organs, aside from

the condition to be relieved by the operation, *i. e.*, if the bloodvessels, heart, lungs, kidneys, liver, pancreas or spleen, or the blood be seriously impaired, it is well to overcome this fault unless it is directly the result of a condition which is to be relieved by the operation itself and will probably improve much more rapidly after than before the operation. This is especially true in patients suffering from anemia. If such anemia depends upon a loss of blood which will be stopped by the operation, then the recovery will usually be exceedingly rapid after the operation has been performed; if due to other causes the patient's recovery will be very slow unless the anemia is relieved before the operation is done. If no important organ is seriously impaired it is much better not to worry the patient unnecessarily before the operation. As a rule, long-continued preparatory treatment leaves the patient in a much less favorable condition for a surgical procedure than a very short and simple preparation which serves to put the kidneys, the skin and the alimentary canal in a state favorable to the elimination of the waste products.

The Day Before Operation.

During the day before the operation the patient should be kept on light diet, consisting of sterilized food, preferably broth or gruel, and allowed an abundance of good water, preferably hot, in order to favor elimination through the kidneys. A non-irritating cathartic should be given and, if possible, a warm bath. For several years we have given, as a rule, two ounces of castor oil in the foam of beer or malt extract the day before an operation, and a large soap and water enema, or one consisting of normal salt solution, on the morning of, or on the evening before the operation. In this manner the patient is relieved in a relatively short time of much waste matter and is consequently removed from the likelihood of absorbing the products of decomposition which may be present in the alimentary tract. We have found that so large a dose of castor oil is borne perfectly by almost all patients, and that it does not give rise to disturbance, pain or exhaustion. We have also found that foam of beer or malt extract disguises the oil so thoroughly that those who are ordinarily nauseated very readily will bear this method without annoyance.

Prolonged Preparatory Treatment Condemned.

In the vast majority of patients this amount of preparation suffices to relieve the body of any burden it may possess which might interfere with the progress of healing, or the normal course of convalescence. In other words, the patient approaches the operation in a comparatively clean condition; his strength has not been impaired by confinement and his nervous system has not suffered by looking forward to the operation for a long time. Some years ago we had the opportunity to observe the effect of waiting for a number of days, and sometimes for several weeks, to allow the patient to get into a more favorable condition for operation, and we are positive that as a rule the practice is bad. The exceptions are in those patients in whom the heart, the kidneys or the blood are too seriously impaired, and who might be placed in a better state by waiting; and in cases in which infection is present which may become circumscribed or may be eliminated.

We will refer to these conditions again in connection with patients in whom they are present; and will especially refer again to old age, because elderly patients bear many operations remarkably well if they are not con-

fined before, and only for a short time after, the operation, while quite the opposite is true if this precaution is overlooked.

THE FIELD OF OPERATION.

Immediate Preparation Sufficient.

In hospitals where many operations are performed on the same day, so that the time spent over each case, immediately preceding an operation, is of importance, it may be well to prepare the field of operation on the day before, but this is done simply as a convenience, and not because it is better than it would be to prepare the field of operation immediately before beginning to operate. For months at a time we have followed the latter plan without having a single wound infected, and other surgeons have had the same experience, hence there can be no good reason for insisting upon having the field of operation prepared one or more days before the operation. However, this may be done as a matter of convenience.

Details of Surface Preparation.

The important point in preparing a surface for operation lies in thorough washing with soap and water; anything that is accomplished beyond this is of little importance, provided the washing process has been done carefully and thoroughly. In our practice the steps taken in preparing the field of operation are as follows: 1, Thorough scrubbing with soft soap and warm water with a moderately stiff brush; 2, Washing the surface with a piece of aseptic gauze saturated with fresh water, because the epithelial scales which have been loosened with the brush are easily removed in this manner; 3, Soaping and shaving the field of operation; 4, Washing again with aseptic gauze and sterile water; 5, Washing the surface with commercial, *i. e.*, about ninety-five per cent., alcohol; 6, Washing with a solution of corrosive sublimate, one part in two thousand.

In many cases only the first four, or the first five steps were taken and always with the same results, consequently we are confident that careful washing of the surface with soap and water is the important part, but as there can be no harm in the other two procedures they might as well be taken, so long as it is convenient in any given case.

Use of Antiseptic Fluids.

There is still a distinct superstition in favor of the use of some antiseptic fluid for washing the field of operation, and so long as the fluid employed is harmless we believe that we are justified in using it. If this preparation is made just before beginning the operation it will suffice, if made on the day before the operation the surface must be protected against re-infection during the interval; this can be done by applying sterile gauze or cotton to the surface, holding it in place by means of a carefully applied bandage. On the following day the surface is once more washed with a piece of sterile gauze saturated with alcohol and is then ready for operation.

Avoid Skin Irritation.

It is important not to irritate the skin by the violent use of a stiff brush or the careless use of the razor, and care should be taken to have the razor sterilized. It is an easy matter to irritate the skin during vigorous or violent preparation to such an extent that the microorganisms normally

contained therein will be forced into activity, making at least a slight infection certain to occur.

It is much better simply to wash the field of operation very gently with soap and warm water with a soft piece of gauze than to use any method, however thorough it may seem, which will leave the skin in an irritated condition.

Sterile Towels About the Wound.

In order to prevent infection of the field of operation from any of the adjacent surfaces, it is well to lay four sterile towels around the part and hold them in place by means of safety pins, or better still by the use of forceps with sharp beetle-like mouths which will grasp the towels, together with a little of the underlying skin, and will thus prevent slipping of the towels. The space exposed should be large enough so that the towels need not be shifted during the operation, because such an act is likely to cause infection by carrying micro-organisms on the under surface of the towel from adjacent portions to the field of operation. During the operation these towels should be left in place, and in case they have become soiled they should be covered with fresh towels, but otherwise they should not be disturbed or removed. Again, when the operation has been completed the greatest care should be exercised to protect the wound while these towels are removed. This can be done very easily by placing a piece of moist, aseptic gauze over the entire surface of the wound and leaving it in place until all the necessary disturbance has been completed, then carefully sponging the surfaces around this pad, and at last removing the pad and covering the wound with proper dressings.

Avoid Infection from Surrounding Parts.

During the operation it is best to handle the tissues as little as possible, and to do this with instruments as much as may be, and as little as possible with the hands, and never to manipulate the patient's skin first and then the wound, because the epidermis almost always contains some micro-organisms which might be transferred to the wound.

A practice which should be guarded against consists in first sponging all about the wound and finally the wound itself. If the skin about the wound be sponged at all, the same sponge should not be used in or upon the wound thereafter.

Tincture of Iodine in Crushed Wounds.

Recently a method of disinfection of the field of operation with tincture of iodine has been recommended by Grossich, which has the excellent qualities of being simple, convenient, safe, efficient and generally applicable. The method has been further developed and perfected by Bogdán, whose plan is worthy of adoption, especially in cases which have sustained severe crushing injuries in which the method described above is not altogether satisfactory because in scrubbing the areas surrounding the wound much of the dirt is certain to drain into the wound during the process of disinfection, and it is questionable whether the harm which will be done by this soiling of the wound is not greater than the benefit derived from the disinfection.

Iodine and Benzine.

Bogdán's method consists in making a solution of one part of iodine

crystals in one thousand parts of benzine, which can be readily accomplished by adding one drachm of iodine crystals to the gallon of benzine or one gram to the litre.

The entire area to be disinfected is carefully shaved dry in case the portion of the body is covered with a perceptible growth of hair, it is then rubbed off carefully with pledgets of sterile gauze saturated with this fluid. This is repeated several times, the disinfection of a large area consuming not more than two or three minutes. When the benzine has evaporated the entire surface is painted repeatedly with tincture of iodine, also for a period of about two minutes, pledgets of sterile cotton being used for this purpose. As soon as the alcohol contained in the tincture of iodine has evaporated, leaving the area perfectly dry, the operation may begin. This method has proven most satisfactory and may be employed as well in other than traumatic cases, although in non-traumatic cases there is not the same necessity to vary from the method described at the beginning of this section.

Caution in Use.

In these cases the patient should be given a thorough soap and warm water bath on the day before the operation, and the operative area should be soaped and shaved and again washed with warm water in order to reduce the time necessary for preparation on the day of operation, when the remaining steps in the process of disinfection described above should be carried out. It is important to bear in mind that the use of benzine is extremely dangerous in the presence of gas-light or fire of any kind, consequently, in preparing the field of operation, quite as much care should be taken when this method is employed as when ether is used.

As this is always undertaken by thoroughly trained nurses or physicians, the danger is not really very great in case their attention is directed to this factor.

PREPARATION OF THE HANDS.

What has been said concerning the preparation of the field of operation applies very closely to the care of the operator's hands before an operation.

Details of Hand Disinfection.

The important point is to make sure of careful, thorough washing with soap and sterile water, then cleansing the space underneath the finger nails, then washing again, first with a moderately soft brush and then with a piece of gauze. We have found it an advantage to wash in a deep basin full of warm, sterile water, keeping the hands under water while scrubbing with the brush and washing with the gauze pad, and then to wash in sterile running water after the hands have been thoroughly scrubbed underneath the soap suds.

Smooth Skin.

It is important above all things to keep the skin upon the hands smooth and soft, and not covered with grooves and crevices. If the surgeon's skin is smooth it is much easier to keep the hands aseptic than if it has been roughened by the use of strong antiseptic solutions. There is a great difference in the skin of the hands of different surgeons, and consequently it is wise for each one to avoid the antiseptic solution which happens to be

harmful in his case; and if all solutions have the same effect, it is wise simply to wash with soap and sterilized water, because smooth hands can be rendered perfectly safe in this way, while rough hands cannot be made safe by the additional use of any one of the various antiseptic solutions which have been recommended.

Even the employment of certain varieties of soap has a ruinous effect upon the hands of some surgeons, but with them it is always possible to determine experimentally what variety of soap has this harmful effect and by changing the ingredients so as to neutralize the substance which gives rise to the irritation it is practically always possible to overcome this difficulty. Should the hands, however, become roughened notwithstanding the exercise of all of these precautions this can usually be overcome readily by systematically caring for the hands at the end of the day in order that during the night's rest the skin may recover from the day's irritation.

To Overcome Roughness of the Hands.

The hands in these cases should be washed before retiring with a soft cloth in a deep basin filled with exceedingly hot water to which a sufficient amount of non-irritating soap has been added to make it smooth, or in case all soap causes irritation, bran may be added to the water. The water should be just as hot as can be borne and the washing should be continued for several minutes until the hands are thoroughly hot. Then they should be plunged into cold water, that is, having the ordinary temperature of the water supply in most cities. After a minute the hands are to be dried and anointed with lanoline and covered for the night with soft chamois skin gloves. In most instances this course will entirely and speedily overcome the roughness of the skin.

In our own practice we follow the washing with soap and water by the use of strong alcohol, and then a solution of corrosive sublimate, one to two thousand.

Avoid Pus.

In hospital practice there are certain other precautions which are of exceedingly great importance, largely in the way of prophylaxis, which will aid greatly in securing aseptic conditions. The most important of these is to keep the hands out of pus. In dressing suppurating wounds either forceps or rubber gloves should be used, so as to prevent the hands from touching pus. Operations should be performed early in the morning, before any one connected with the wounds has done any dressings. Puddling in pus is pernicious practice. This fact should be impressed most forcibly upon every one connected with the work.

Aseptic cases should always be operated first, and later those containing pus. In operations upon suppurating cases rubber gloves are used at the present time, but in former years, by taking the precautions indicated above, practically no infections took place, although no gloves were worn.

Antiseptic Conscience.

The same precautions should be taken in dressing the wounds—no suppurating wounds being dressed until all the clean wounds have been finished. Every evening before retiring the surgeon and all the assistants should scrub their hands with the same care that is employed in disinfection before an operation. It is absolutely necessary for every one connected

with surgical work to develop an antiseptic conscience, because upon this depends the condition of the wounds rather than upon any special method.

It is a comparatively easy matter to secure an aseptic condition of the hands before the operation, but it requires great vigilance on the part of every one associated with an operation to maintain this condition throughout the procedure. Unless each has an antiseptic conscience some one is likely to touch something which is not surgically clean and transfer the infectious material with his hands to the wound. In order to become thoroughly impressed with the ease with which this can be accomplished, every surgeon should take a practical course in a bacteriological laboratory extending over a number of months, because the same carelessness which will ruin a culture plate may cause a wound infection, and one really cannot fully appreciate how easily this occurs until after having had the experience of ruining a lot of pure cultures in bacteriological experimentation.

RUBBER GLOVES.

If a surgeon has not a smooth, pliable skin, or if for any reason it seems difficult to obtain perfectly clean hands by washing, or if he has recently touched infected wounds, or performed autopsies, or dressed suppurating cases, it is well to protect the patient to be operated by wearing aseptic rubber gloves.

Objections.

It should, however, be borne in mind that the surgeon loses much in dexterity in this way, and being deprived of the finer sense of touch his skill is quite materially impaired, and in some very delicate operations this impairment may be sufficient to deny the patient the slight chance he had of surviving the operation. Of course, this would apply to only a small proportion of all the patients operated upon, but it is large enough to be worthy of consideration.

It is quite different with the hands of assistants and nurses connected with operations. These can perform the less delicate duties which are entrusted to them as well with gloves as with bare hands, and consequently the additional safety which comes from covering their hands with aseptic rubber gloves is of sufficient importance to recommend their use.

Details of Use.

In using gloves it is of the greatest importance to disinfect the hands with the same care as when no gloves are used, because a glove may tear or become punctured at any time during an operation. In case this happens the glove should be discarded at once, as a torn glove is necessarily much more dangerous than no glove at all, its warmth and moisture having a tendency to loosen the epithelium which may contain pathogenic micro-organisms.

Confirm Necessity for Gloves.

It is important for each individual surgeon to determine definitely whether or not it is possible for him to absolutely disinfect his hands. This can be done easily by taking scrapings from his fingers, especially from portions underneath and at the base and sides of the finger nails. If a surgeon's hands contain micro-organisms after he has disinfected them, then it will not be safe for him to operate without wearing rubber gloves. There

is such a vast difference between the hands of different surgeons that a rule for the disinfection of the hands of one cannot properly apply to others without confirmation by carefully carried out bacteriological tests.

DISINFECTION OF INSTRUMENTS.

All instruments, except knives, should be boiled for half an hour in a solution of a tablespoonful of baking soda to the quart of water before they are put away after operations, and again before they are used. The knives are washed carefully with pads of sterilized cotton, saturated with alcohol before and after using.

DISINFECTION OF SILK, SILKWORM GUT, HORSE-HAIR, DRAINAGE TUBES AND BRUSHES.

This is accomplished by boiling in water for one hour, and preservation in five per cent. solution of carbolic acid in water, or in strong commercial alcohol, until used.

Method of Preparing and Preserving Catgut.

Catgut is prepared by immersing in sulphuric ether for one month, then for one month in strong, commercial alcohol, in which one grain of corrosive sublimate to the ounce has been dissolved, the solution being renewed once during this time. It is then preserved indefinitely in a solution of one part of iodoform, five parts of ether and fourteen parts of strong, commercial alcohol. In this solution catgut may be preserved with perfect safety for many years in jars which prevent the evaporation of the ether. The loss of ether from the jars which are opened occasionally for the removal of catgut to be used from day to day may be made good by adding ether occasionally when it is noticed that iodoform is becoming precipitated at the bottom of the vessel.

It is not necessary to be accurate concerning the amount of ether replaced because an excess in no way injures the catgut. The entire substance of the catgut becomes thoroughly permeated with fine crystals of iodoform, which remain in the suture until the last portion of catgut fibre has been absorbed. This is a marked advantage over catgut saturated with iodine in which no trace of this antiseptic can be found two days after the introduction of the buried suture. It should never be handled by any one except the surgeon and the chief assistant. This catgut will last seven to ten days in tissues, according to the size used. It is employed in all ligatures, both in the peritoneal cavity and elsewhere, and for all buried sutures except in hernias and in the suturing of bones. For these purposes a chromicized catgut is employed, which lasts from fifteen to thirty days, according to size. This is prepared after the following formula: The catgut is immersed in ether for one month, then in a solution prepared in the following manner:

Chromicized Catgut.

- | | | |
|----|-------------------------|----------|
| A. | Chromic acid | 1 part. |
| | Water | 5 parts. |
| | (Carefully dissolve.) | |
| B. | Take of solution A..... | 1 part. |
| | Glycerine | 5 parts. |

Take solution B and soak therein catgut for forty-eight to ninety-six hours, according to resistance wanted. Forty-eight hours will resist absorption by tissue for fifteen days; ninety-six hours will resist for thirty days.

C. Take catgut out of solution B, rinse quickly in sterilized water to free it from solution B, stretch and rub quickly with a hard, sterile towel to remove any of the solution B which may still be adhering to it, wind on rods, or slides at least three inches in length and preserve indefinitely in the following solution:

D. Carbolic acid, 95 per cent.....1 part.
Glycerine5 parts.

The catgut may remain in this solution for many months without depreciating in quality, or it may be kept for an indefinite period of time in the same solution as the ordinary catgut, composed of:

Iodoform 1 part.
Ether 5 parts.
Strong alcohol14 parts.

The jar containing the ether in which the catgut is kept for one month should be filled only about one-half with the loose coils of catgut and then it should be filled with ether; it should be closed air tight and should be picked up every day or two and shaken in an inverted position in order to wash off any substance which may accumulate upon the surface of the coils. At the end of two weeks the ether should be removed and fresh ether substituted.

The same precautions should be taken with the solution of corrosive sublimate in alcohol.

It is especially important not to wind the catgut tightly before placing it in these solutions, because this may prevent the solutions from penetrating all parts of the material.

One precaution is necessary in the employment of catgut which has been prepared in this manner; it must not be placed in water before it is used at the time of the operation.

It seems that the iodine which is absorbed by the catgut in the iodoform-ether-alcohol solution makes it slightly antiseptic, which is probably an advantage.

Upon splitting a piece of catgut which has been preserved in this fluid and permitting it to dry it will be found that the entire substance is permeated with fine crystals of iodoform which will be absorbed no more rapidly than the catgut itself, thus making the latter slightly aseptic until it is entirely absorbed.

This seems to be of importance especially in the use of chromic gut because of the length of time it normally remains in the tissues.

These two methods are so simple that they can be carried out as well in the simplest office of the country practitioner as in the laboratory of a well-organized hospital.

Experience Results.

We have personally used catgut prepared in this manner in more than twenty thousand operations, and the fact that we have adhered to this method of preparation, while we have changed almost every other detail in antiseptic

technique in the meantime, shows that this very simple method must be satisfactory.

Catgut Infection.

Observations have convinced us that what is ordinarily known and feared as catgut infection is quite unnecessary and that it depends upon one or more of five conditions which can easily be eliminated, viz.: 1, Commercial catgut which may not be reliable; 2, Catgut that has been saturated with antiseptic substances which cause a necrosis of the tissues included in the suture or ligature; 3, Pressure necrosis due to tying the stitches too tightly; 4, Infection of the catgut by careless manipulation by the surgeon or his assistants, the suture or ligature being permitted to touch objects not sterile; 5, Infection of the catgut by the septic hands of the surgeon or his assistants.

Although drawing sutures or ligatures tightly enough to cause pressure necrosis cannot produce infection by itself, this is, nevertheless, a very common, if not the most common, cause of what is termed "catgut infection," inasmuch as this furnishes a very favorable culture medium for any accidental infection which may occur during the operation and which would not develop into suppuration were not the tissues impaired by the constriction due to the undue tension placed upon the stitches or ligatures.

It has seemed to us that much of the improvement in aseptic results which many surgeons have attributed in their practice to the use of rubber gloves must be due to the fact that the wearing of gloves which have an exceedingly smooth surface has prevented them from tying their stitches and ligatures too tightly and that this explains the decrease in the amount of catgut infection in their experience.

This point is so important that we shall refer to it again in connection with the various operations in which its neglect is especially likely to cause mischief.

Importance of Safe Catgut.

We have spoken at length concerning catgut, because if properly prepared and used it is certainly an ideal suture and ligature material, and it is important to have this material so that it can be invariably relied upon. Undoubtedly some manufacturers furnish catgut in a condition in which it can always be depended upon, but it is difficult to ascertain which of these firms are reliable, consequently it is best for each surgeon to prepare his own material. In large hospitals this can, of course, be delegated to a dependable person who is permanently employed and who fully comprehends the importance of his task. It is not well to assign assistants who frequently change their service to undertake this work, because then it is impossible for the surgeon to fix the responsibility.

IODINE CATGUT.

Catgut impregnated with iodine has been in use for a number of years and has given excellent satisfaction to those who have used it constantly. The presence of this antiseptic material seems to increase the safety of the suture or ligature substance because it may serve to destroy any micro-organisms which may have been introduced accidentally during the operation. However, the especial value of this method lies in its simplicity and in the fact that the tensile strength of the catgut is but slightly impaired by the

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process of preparation. The fact that the iodine is entirely absorbed long before the catgut disappears makes this suture material slightly less desirable to use than that prepared by the method described above. It is, however, possible to preserve this suture material indefinitely in the same iodoform-ether-alcohol mixture that we use for the catgut already described if the catgut is first carefully prepared by the iodine method, especially if the most excellent process invented by Willard Bartlett, of St. Louis, is chosen.

Willard Bartlett Method of Preparing.

In order to secure uniformly satisfactory results it is important to carry out the various steps laid down in the following description of the method with the utmost accuracy, because if any change is made in these steps the catgut is likely to become somewhat hard or brittle. It is also important, to remember that the method must never be attempted in wet weather or in a room containing steam or moisture.

"1. The strands are cut into convenient lengths, say thirty inches, and made into little coils about as large as a silver quarter. These coils in any desired number are then strung like beads onto a thread so that the whole quantity can be conveniently handled by simply grasping the thread."

"2. The strings of catgut coils are dried for four hours at the following temperatures: 160, 180, 200, 220 degrees, one hour each, the changes in temperature being gradually accomplished.

"3. The catgut is placed in liquid albolene, where it is allowed to remain until perfectly 'clear,' in the sense that the term is used in the preparation of histological specimens. This is usually accomplished in a few hours, though it has been my custom to allow the gut to remain in the oil over night.

"4. The vessel containing the oil is placed upon a sand bath and the temperature raised during one hour to 320 degrees F., which temperature is maintained for a second hour.

"5. By seizing the thread with a sterile forcep the catgut is lifted out of the oil and placed in a mixture of iodine crystals one part in Columbian spirits (deodorized methyl alcohol) one thousand parts. In this fluid it is stored permanently, and is ready for use in twenty-four hours; the thread is then cut and withdrawn.

"It seems to me important that the gut should be thoroughly 'cleared' before the oil is heated, in order that we may thus be certain that the temperature of the center of the strand becomes as high as that of the oil outside. It may be noted further that I do not remove the oil from the gut before placing it in the storing solution. This is done purposely, since catgut which is perfectly free from oil is so very sensitive to the action of water that it readily untwists and becomes tangled after it is used in a wound but a few moments. This storing fluid simply takes off enough oil from the exterior of the strand so that it is not too slippery for use, and the albolene being a bland, non-irritating substance, there is no reason why it cannot be safely left in the gut. The iodine rapidly permeates the strand; the same will be found stained black after a few hours, and consequently the surgeon will have the assurance that he is introducing an antiseptic as well as a thoroughly sterile suture material.

"As far as the tensile strength and pliability of the finished product are concerned, I may state that this leaves nothing to be desired. I have made

a large number of breaking tests, and have found no other heat method to produce a stronger strand. Catgut treated in this way lasts in the tissues about as long as the same sized strand treated by most of the other methods in vogue at the present time, the No. 2 gut generally requiring about one week for its absorption. I have not found that the material so treated deteriorates at all with age, neither as far as strength or sterility is concerned. In fact, I have recently had a large number of strands bacteriologically examined from a jar which had been frequently opened during the past year, and have yet to find the first one infected or in any other way undesirable for use in surgery."

All material that can be boiled for one hour is perfectly safe to use for sutures which are to be removed because such boiling ensures the sterility of the material at the time it is placed in the wound, provided it is not infected during its introduction. Of course, it may be infected while passing through the skin or from micro-organisms which progress along the suture between the time of its insertion and the time of its removal, or from micro-organisms existing in the blood which may become located at this point of traumatism, but if the stitches are not tied too tightly this result is not likely to occur, because there will not be a favorable culture medium along the stitch unless prepared by pressure necrosis.

TANNED CATGUT.

Ssobolew Method.

The catgut is wound loosely upon glass slides. It is immersed for 24 hours in extract of quebracho to which one per cent. of phenol has been added. It is then washed in sterile water and immersed for 24 hours in an aqueous solution of formalin actually 4 per cent. but 10 per cent. of commercial formalin in water. It is then washed for 24 hours in running water, then boiled for 15 minutes in water and while still hot it is immersed in a mixture of 96 per cent. strong commercial alcohol 91 parts, glycerine 5 parts and phenol 4 parts. In this solution it may be preserved indefinitely, being washed in water to remove the phenol before using.

It may also be placed in this mixture for a time and then preserved indefinitely in the iodoform, ether, alcohol mixture previously described.

The finest catgut will absorb in not less than two weeks, and the larger sizes in from two to six weeks.

Ligature Material Boiled in Paraffin.

Of the boilable materials for suturing silk, linen, either plain or covered with celluloid, also these materials boiled in paraffine at a temperature not to exceed 150 degrees C., or in 10 per cent. of iodoform in paraffine, may be employed with perfect safety provided the sutures extend through the surface so that they may be removed or that only the very fine threads are used in case of buried sutures or ligatures.

Hyper-tension Favors Suppuration.

Many surgeons complain of suppuration when using catgut for ligatures and buried sutures who are much more fortunate when they use for these purposes only the finest silk or linen. We are convinced of the fact that this is due to the circumstances that when using catgut an amount of tension is applied in tying the sutures or ligatures which would break the fine silk or linen and consequently when using the latter material these surgeons cannot

cause the same amount of pressure necrosis as they can when using the much heavier catgut.

DISINFECTION OF DRESSINGS.

All dressings should be disinfected in a steam sterilizer, two hours being given for steaming and one hour for drying. The same treatment is given to aprons, sheets and towels.

One-fourth of this time is quite sufficient to make surgical dressings absolutely sterile, as has been demonstrated by hundreds of experiments, and if this work is in the personal care of one who has been entrusted with it for a long period the time may be reduced accordingly, but if it is assigned to the nurses in general, it is better to allow more time than is actually required, as no harm is done to the dressing material by exposing it the additional time to the superheated steam in the sterilizer.

The dressings should be arranged in packages and placed in heavy muslin bags or folded in thick towels securely pinned so that the contents will not be contaminated when these packages are handled.

Each package should be labeled by writing the name of the contents on the covering with lead pencil, or if permanent bags are used always for the same contents these may be permanently labeled with indelible ink in order that it may never be necessary to examine the contents to find what may be wanted.

DISINFECTION OF EVERYTHING COMING DIRECTLY IN CONTACT WITH WOUNDS.

The basins, instrument pans, jars for dressings, etc., are to be boiled in soda and water for one hour, then wrapped up in sterilized sheets until used. The tables should be scrubbed with soap and water and then with 1:1,000 corrosive sublimate in water, and have them always covered with a double sterilized sheet when in use. The ordinary pads of cotton and of gauze, sterilized in a steam sterilizer, are used in place of sponges in all operations.

A one per cent. solution of formaldehyde in water is very satisfactory for washing all of these apparatus and especially for the purpose of disinfecting bath tubs and stationary wash basins. The latter should, however, never be used in operating rooms where all the basins for washing the hands of the surgeon, assistants and nurses are so arranged that they can be removed from the stands and boiled, a sufficient number of these removable basins being kept ready so that they may be replaced by sterile ones between operations.

The nurses who scrub these various utensils with these strong antiseptic solutions should invariably wear thick rubber gloves while performing this portion of their duties, because the skin of their hands will otherwise become roughened and thus constitute a danger to the service owing to the ease with which infectious material may become lodged in the crevices formed.

DRAINAGE.

When Used.

Drainage is always used in very large wounds such as breast amputations with removal of the pectoralis major and minor muscles and axillary

glands, also in thigh amputations, usually only for three or four days; never in herniotomies except for strangulated hernia complicated with gangrene, nor in small, clean wounds.

Rubber Tubing.

The ordinary perforated rubber tube is employed. It is always used in wounds that are primarily septic; and whenever there is any doubt as to the aseptic condition of a wound we drain. We have found the use of an ordinary leather punch very convenient for making the necessary perforations in rubber tubing. In many instances, rubber tubes split longitudinally throughout seem to be especially useful.

Glass Tubes.

In wounds in which the pressure from the dressing would be likely to cause collapse of a rubber drainage tube, as, for instance, in operations for the removal of goitre, the small perforated glass tubes introduced by Kocher are most satisfactory. They may be kept on hand in various forms both straight and curved, and in various lengths and sizes, in order that they may suit the conditions found in any given case.

In the abdominal cavity we use glass tubes, closed at the end, having a number of small perforations toward the lower end. A strand of gauze is carried to the bottom of the tube to act as a capillary drain. A piece of iodoform or formidin gauze, folded about four double, is placed over the glass tube, which is then, with this covering, carried down to the point to be drained. In operations upon the pelvic organs it is carried to the bottom of the cul-de-sac of Douglas.

CIGARETTE DRAIN.

In order to prevent the formation of adhesions between portions of the intestines which come in contact with the gauze covering the glass drain the latter is surrounded on the side directed toward intestines or stomach by a row of so-called cigarette drains, introduced by Robert Morris. These drains are made by placing one or more layers of gauze upon a piece of gutta percha tissue so that the former is two or three cm. longer and five or more cm. narrower than the latter. The gauze is then rolled up inside of the tissue so that it will be entirely covered by the latter and so that its ends will project slightly from either extremity, giving the drain the appearance of a cigarette varying in size according to the area to be drained. Thus a capillary drain is constructed which is surrounded by a non-irritating, soft, pliable covering of gutta percha tissue.

A similar drain can be made by splitting a soft rubber drainage tube longitudinally and placing a strand of gauze within its lumen.

In order to prevent adhesions and also to facilitate drainage, flat tapes of sterile gauze saturated with vaseline oil may be used.

The gutta percha tissue may be disinfected by washing in one to one thousand of corrosive sublimate in water and by exposing the moist sheets to the fumes of formaldehyde. The material will not bear disinfection by boiling or by exposure to steam.

IRRIGATION.

We practically never use irrigation during operations, either in the abdominal cavity or elsewhere.

[During the early days of my surgical work, as an assistant, I observed that wounds in abdominal sections healed more smoothly than in other operations, and the only real difference in the treatment observable was the fact that no irrigation was used in connection with the former, while it was invariably employed in the others. I consequently applied the same plan of treatment to all wounds as early as 1889, and have since constantly operated dry in clean cases, and, since a number of years, also in cases containing pus. I have treated wounds in circumscribed tuberculous lesions by applying strong compound tincture of iodine, and then sponging the area with moist gauze sponges before tamponing with iodoform gauze or before closing with sutures. These wounds have progressed well, but I do not feel convinced that the iodine has been responsible for this fact. Very recently in tuberculosis of the joints I have applied strong carbolic acid to the surfaces of the bones for two minutes, and have then washed these parts thoroughly with strong alcohol until all of the carbolic acid seemed removed. I am convinced that irrigation is rarely of any real benefit and that it is frequently harmful in carrying infectious material to portions which might otherwise have escaped infection.—Ochsner.]

Primary Union Depends Upon Thorough System.

Our observations have convinced us that it is an exceedingly simple matter to obtain primary union almost invariably if one has a reasonable system, *i. e.*, a system which keeps the attention of operator, assistants and nurses constantly on guard to prevent accidental contamination.

Whenever some new method is on trial in any hospital or clinic every one is interested and, consequently, accidental contamination is not likely to occur. It is for this reason that the various new methods are so successful in the hands of their originators.

Theory vs. Practice in Surgical Methods.

A close observation of antiseptic and aseptic surgery from its beginning to the present time has led us to the conclusion that there is a vast amount of difference and contradiction between the theories, which are at present generally accepted, and the practical results. So far as a scientific study of the subject is concerned, both the theoretical considerations, which are mainly based upon scientific experiments, and the practical observations upon wounds, must be borne in mind. So far as the welfare of any particular patient, or any group of patients, is concerned, only those facts which practice has shown to be of importance in order to secure primary union should be considered, because they will bear directly upon the welfare of a human being who has entrusted himself to our care. The following conclusions will serve to express my position upon this subject.

1. (a) Theoretically it is almost impossible to absolutely disinfect the skin of the patient and the hands of the operator.

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- (b) Practically it is one of the easiest and simplest tasks to obtain a degree of surgical cleanness that will insure primary wound-healing.

2. (a) Theoretically, strong chemical disinfectants are indicated for the purpose of disinfecting the hands.

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- (b) Practically, careful washing with the mildest, *viz.*, soap and water and alcohol, is absolutely sufficient and very much safer for the patient, because hands roughened by the use of strong antiseptics are much

more prone to become hopelessly septic than hands which are covered with smooth, healthy skin.

3. (a) Theoretically, it is extremely simple to keep the hands aseptic after they have been rendered so.

(b) Practically, there is no more difficult task in any clinic, or during an operation in a private house, than to keep all interested hands clean after they have been disinfected.

4. (a) Theoretically, sutures passing through the skin and the deep tissues underneath are a menace to the patient, because they form a direct communication between the skin, containing staphylococci, and the deep tissues which are primarily sterile.

(b) Practically, these stitches never cause an infection, unless drawn too tightly, in which case the resulting pressure necrosis is the cause of the mischief as it furnishes these micro-organisms dead tissue to thrive upon.

5. (a) Theoretically, catgut sutures and ligatures are objectionable

(b) Practically, if applied properly by a clean surgeon with clean assistants, and not tied too tightly, they are absolutely satisfactory and not objectionable.

6. (a) Theoretically, it is as safe to operate upon clean cases after dressing suppurating wounds as at any other time.

(b) Practically, surgeons who follow this practice always have a great amount of wound infection, on account of accidental contamination of something coming in contact with the wounds.

In order to have wounds heal without suppuration we believe the following conditions should be enforced:

1. The surgeon, his assistants and nurses, must be habitually clean, and the skin of their hands must be free from irritation and roughness.

2. Their attention should constantly be directed toward the prevention of accidental infection.

3. The surgeon and his assistants should be careful not to breathe or speak into the wounds.

4. Tissues should not be exposed to unnecessary traumatism.

5. Sutures should not be tied tightly enough to cause pressure necrosis.

6. A reasonable system should be employed so that every one concerned can assist intelligently in preventing infection.

THE OPERATING ROOM.

Direction of Light.

The hospitals of this country are all supplied with suitable operating rooms, with the one criticism that many of them are badly-lighted. The light should come from the north and from sky-lights facing north, in order to have uniform brightness and not direct sun-light and to avoid the overwhelming heat which is caused by sky-lights facing the sun.

In great cities operating rooms should be on the highest floor in high buildings, because the air contains much less street dust in the upper stories of a high building than near the ground, and consequently less infectious material is likely to accumulate in places from which an infection can be carried to the wounds.

Advantages of the Hospital.

Operations are always best performed in hospitals, and every city and town in the country should support a hospital suitable in size to the community tributary to it. This can be established and maintained at a small cost and is of great benefit to the community because it supplies a means of proper treatment for cases which must otherwise be satisfied with generally very inefficient care. Moreover, it serves as the most powerful incentive for the entire medical profession in the community in which it is maintained because it furnishes a reasonable opportunity for advancement.

The Leading Consideration in the Private Home.

But many operations must for the present be performed in the homes of patients and here it might be considered more difficult to arrange an operating room. As a matter of fact there is but one point to be borne in mind in the arrangement of a room for operating, namely, infection, and that no wound infection is to be considered except from contact. Not that infection from the air is absolutely impossible theoretically, but that, practically, a wound remains aseptic unless infectious material has been placed in it by dirty hands, dirty instruments, appliances or sponges, ligatures, sutures or dressings, unless the infectious material existed in the patient's body at the time of operation. Of course the operator could infect a wound by breathing or speaking into it if his pharynx or air passages were infected.

Universal Cleanliness Required.

But in any case in which a clean surgeon with clean assistants and clean appliances operates upon a clean patient, it can be expected with a fair degree of certainty that the wound will remain aseptic, no matter what the surroundings may be. On the other hand, the most perfectly appointed operating room cannot prevent a septic surgeon from having his wounds in clean patients suppurate.

Details of Preparation in the Private Home.

It is best, when compelled to operate in a dwelling house, to choose the lightest room, to make as little disturbance as possible, and thus avoid stirring up dust, to arrange everything very simply and to utilize the least possible amount of furniture. An ordinary extension table will serve admirably for an operating table. Let it be drawn out so that there is a space of about three feet in the center and then two of the boards may be placed lengthwise so as to leave a notch on one side for the surgeon to stand and on the other side for his assistant. A quilt or blanket may be folded upon itself three or four times and placed lengthwise upon the table and this covered with a freshly laundered sheet. A small stand or table is placed at the side of the operator and covered with a sterile towel, and on this are placed the instruments, ligatures, sutures and sterilized dressings. Upon chairs or a bench, or another table, two or three basins are placed containing boiled water. Into one of these a sufficient number of tablets of corrosive sublimate are thrown to make a solution of 1-2,000.

After preparing the surface to be operated, and the surgeon's hands as described in a previous section, the operation may proceed, but every one connected with the work must bear in mind throughout the operation that nothing is to be touched by any one except those things that have

been sterilized. If anything has been touched by accident or intentionally, the hands of such person or persons must again be disinfected.

It is not at all uncommon after making the most careful preparations for an aseptic operation to have some one who comes in contact with the wound, directly or indirectly, thoughtlessly produce an infection by handling some object which is not sterile. If it is necessary to depend upon unskilled assistants, it is well to cover their hands with sterilized rubber gloves and to virtually perform the operation alone. It is well to carry a good supply of sterilized towels and dressings in order to be able to cover everything in the vicinity of the operation.

Instruments may be carried sterile in a canvas roll and covered with a sterile towel, and the ligatures and suture material may be carried in bottles. Basins may be placed in a wash boiler and sterilized by boiling while the preparations are being made for the operation.

Sterilized gauze may be cut in suitable lengths to serve as sponges.

From this it will be seen that it is not very difficult to prepare an operating room in an ordinary dwelling house, but no operator ever does his best work anywhere except in his regular operating room.

Simplicity of Detail to be Studied.

Whether the operation be performed in a well-appointed operating room or in a dwelling house, much will be gained for the patient if the surgeon appreciates the great value of simplicity. If only that is done which is actually of value to the patient, much will be gained for him, because it is through unnecessary manipulations that one is especially likely to carry infection to the wound.

GENERAL ANESTHESIA.

Ether and chloroform are the only two general anesthetics which seem to have stood the test of time; not that they are entirely safe, nor that they are entirely satisfactory, but rather that they are less unsatisfactory than the other substances which have come into use and been discarded again. With chloroform there is a considerable amount of danger at the time of its administration, and in the use of ether there is some danger from pneumonia following recovery from the anesthesia because of the great irritation of the respiratory tract.

The various contra-indications will be considered in connection with the clinical cases wherein they are found. For the present only points of general application will be considered.

General Influences.

The careful general examination which was described in the first sections will have determined any pathological conditions of the heart, the kidneys and the lungs, the three organs especially to be studied by the anesthetist. If one or more of these organs have been found to be pathological it will be wise for the anesthetist to be even more cautious than he would otherwise, if this is possible, and for the surgeon to limit his operation to the very shortest consistent time. The induction of anesthesia should be somewhat slower and the anesthesia just sufficiently profound to permit the operation without disturbance or interruption by the patient.

Organic Heart Lesions Not Positively Forbidding.

Singularly, in our experience patients suffering from organic heart

lesions have never had any serious or alarming difficulty during the administration of an anesthetic, while patients whose heart, lungs and kidneys were normal at the time of administering anesthetics have sometimes shown serious symptoms.

In a symposium on this subject before the College of Physicians of Philadelphia in which many of the most experienced surgeons of this country participated, no one had seen a death from anesthesia in any case in which there had been a demonstrable heart lesion.

No one would reason from this that the former class of patients are better subjects for the administration of anesthetics, but rather that the presence of their unfavorable condition caused the anesthetists to exercise unusual care in all of them.

From this it would seem that it is perfectly safe to give anesthetics in cases suffering from valvular heart lesions, provided this is known at the time the anesthetic is administered. We believe that it also shows that if the same care which has been employed in these cases were regularly taken in all cases, the present low mortality from anesthesia would be still further reduced.

Chloroform Followed by Ether.

The method of administering chloroform followed by ether which has been most satisfactory in our own practice, consists in first quieting the fears of the patient, then applying across the patient's eyes a piece of rubber ten cm. wide and fifteen cm. long and over this a pad of sterilized gauze, six or eight thicknesses, and about three inches wide and eight inches long, held in place by a towel which is pinned around the head so that its lower margin crosses the nose below its middle to protect the eyes against irritation from the anesthetic, and incidentally to soothe the patient by having the eyes closed. The face is then anointed with vaseline to prevent burning with chloroform. An ordinary Esmarch chloroform mask covered with two thicknesses of gauze is then placed over the mouth and nose and chloroform is dropped upon this very slowly but continuously, care being taken to constantly change the point upon which the drops fall so as to apply the chloroform to different parts of the mask with some uniformity. Then the patient is told to count aloud slowly after the anesthetist, who speaks numbers of three figures slowly, then waits for the patient to repeat the same number, then he calls the next higher or lower number. This is continued until the patient is asleep. By choosing a large number to be repeated by the patient the latter exhales freely while counting and later inhales quite as freely while the anesthetist repeats the next number. His attention being directed toward the unusual feature prevents him from causing any voluntary irregularity in his respiration. This causes him to breathe deeply and at the same time to divert his attention from the anesthesia.

So long as the patient counts with loud voice, after the anesthetist, his breathing is fairly regular and there is little danger in the administration of chloroform, provided the gauze covering the mask is not too thick to permit a sufficient amount of air to enter with the chloroform (for this reason only two thicknesses of ordinary gauze should be used).

After the patient has been thoroughly anesthetized with chloroform, and for at least one minute before the operation is begun, ether is administered with the same mask, also by the drop method, with the difference,

however, that the gauze is kept thoroughly saturated with ether and that four layers of gauze are placed on the Esmarch mask instead of two.

Safety of the Method.

When a surgeon is compelled to operate without a skilled anesthetist, which is a very common experience for the practitioner in the country, the administration of the ether can safely be placed in the hands of any one, provided this method be employed. The surgeon can prepare everything for the operation, he can then give the chloroform himself until the patient is asleep, then after giving ether for a minute or more this can be placed in the hands of any intelligent person and the surgeon can again disinfect his hands and proceed to perform the operation. Even in hospitals where there are skilled anesthetists this method is satisfactory.

If for any reason the patient does not take ether well he will frequently take chloroform without disturbance, and it is usually well to change the anesthetic in any case in which there seems to be difficulty with giving one or the other of these two. We have, however, adopted the rule never to return to the use of chloroform in any given case in which this anesthetic is not well taken, fearing that it might result in a serious or even fatal accident.

If a patient does not take ether well it may be disagreeable to continue its use, but it is nevertheless ordinarily safe.

Danger Signals.

There is no sign of danger in the administration of anesthetics upon which one can depend absolutely, but there are a number of signs which should always have immediate and careful attention when they appear. In most cases of danger respiration is at first impaired; in some the respiration and the circulation suffer at the same time, while in others the heart stops beating suddenly before the respiration ceases.

Means of Relief.

In time of trouble we have found greater benefits and prompter relief by first pressing forcibly upon the chest several times, in order to force out from the lungs, as much as possible, the air laden with chloroform, and then by means of artificial respiration supplying pure air in its place.

If no air seems to enter the lungs upon attempting artificial respiration it is well to rapidly place a gag between the teeth and with the finger to raise up the epiglottis away from the larynx; this can sometimes be accomplished very quickly by pulling the tongue forward rapidly with a pair of tongue forceps.

The operator can frequently recognize impending danger to the patient from the anesthetic by the lack of bleeding from the wound and by the dark color of the blood, indicating insufficient aération.

Above all things, the anesthetist should give his entire attention to his work and should never crowd the anesthetic in order to hasten the anesthesia.

Preference Given to Ether.

For several years we have abandoned the use of chloroform anesthesia completely because it has been found that by using the drop method of administering ether, which was first introduced in the Augustana Hospital by L. H. Prince twenty years ago, anesthesia can be accomplished almost without either immediate or remote danger. The amount of ether given is thus exceedingly small, and the patient is completely under its influence, in from

two to ten minutes. In cases in which two ounces of castor oil has been given on the day before the operation, nausea and vomiting rarely occurs. The patient recovers from the anesthetic very rapidly and without pulmonary irritation.

The mask invented by Ferguson, which is constructed of malleable copper wire so that it can be accurately fitted to the patient's face, is most useful; the amount of ether given can be most accurately regulated and much waste is therefore prevented.

Morphin and Atropin Hypodermically.

In patients with irritable bronchial mucous membranes it is well to administer one-fourth grain of morphine and one one-hundredth grain of atropine hypodermically half an hour before beginning the anesthetic. This will prevent the accumulation of frothy mucus during the administration of the anesthetic, which is especially desirable in operations about the neck. This also reduces the amount of ether required for accomplishing satisfactory anesthesia.

It is to be remembered, however, that whatever anesthetic and whatever method of administration may be chosen it is always of great importance to the patient to reduce the time limit to a minimum.

NITROUS OXIDE GAS ANESTHESIA.

During the past twelve years many surgeons have used nitrous oxide gas anesthesia for operations lasting up to and even beyond one hour. This gas has been used safely in an enormous number of dental operations, and in other short term operations for many years with great satisfaction.

No Advantage As An Introductory Agent.

Of late it has been used for general operative work in many cases for the purpose of anesthetizing the patient primarily to avoid the annoyance of taking ether and later continuing the anesthesia with ether or chloroform. In order to determine the value of this method we employed it in one hundred successive cases and compared the anesthesia, the patient's sensations and the condition of the patient after the operation with cases operated before and after this test period under ether anesthesia applied by the drop method. We found no difference in the course of the anesthesia, nor in the comfort of the patient, but there was a little more bronchial irritation following operation when nitrous oxide gas had been used. The method was more cumbersome and consequently it was permanently abandoned. For a time it was necessary to give patients the choice of this anesthetic because they had obtained the idea elsewhere that it was much safer and so some were slightly prejudiced in favor of the method, but aside from this slight advertising value, which the method undoubtedly possesses, we are convinced that it has no especial value as compared with ether properly administered by the drop plan.

The same value is present, possibly to a somewhat greater degree, in the method now more frequently employed of a combination of nitrous oxide gas and oxygen. Here the patient is successively asphyxiated by the use of nitrous oxide gas and resuscitated by the oxygen gas. A skilled anesthetist can accomplish these two processes so cleverly that any operation not affected by muscular rigidity can be performed under this anesthesia.

This Form of Anesthesia Not Good in Intra-Abdominal Work.

In intra-abdominal operations we have found that additional traumatism necessitated by the rigidity of the abdominal muscles causes a great increase in the pain suffered by the patient after operation. This can, however, be overcome by giving from one-sixth to one-third of a grain of morphia with one one-hundredth of a grain of atropine half an hour before the operation is commenced, and by giving morphia after operation in case of pain. The method undoubtedly exposes the patient to conditions which cannot be considered harmless. Were a patient exposed to the same degree of asphyxia, for the same period of time, from any other cause, it seems reasonable to suppose that any physician would look upon this as a severe strain upon the physiological processes. After the newness of this method has worn off, these secondary considerations will undoubtedly receive more careful attention.

Other Contraindications.

It seems wise never to follow this course of anesthesia in any operation lasting longer than a few minutes, unless a well trained anesthetist is available, and then never in plethoric patients nor in cases suffering from cardiac dilatation, myocarditis, valvular heart lesions, nor in those suffering from obstruction to respiration from any cause. Patients with arteriosclerosis or with high blood pressure are also bad subjects for the use of this form of anesthesia.

In cases in which this form of anesthesia seems safe, it is not needed because they do equally well with the use of ether by the drop method, and in cases in which one dislikes to give ether this method is contra-indicated. For some time to come there will be a certain amount of advertising advantage, but as soon as this has been dissipated by the fact that everyone will be prepared to administer this form of anesthesia, its drawbacks must become apparent as compared with its advantages.

Properly Conducted Ether Anesthesia Has All Advantages.

The only real merits are the comfort to the patient in inducing the anesthesia, and the rapidity with which patients regain consciousness. The ether anesthesia when applied properly by the drop method is no less comfortable, and if interrupted when the surgeon begins to apply the sutures the patient will awaken almost immediately after the conclusion of the operation, but will then usually again fall asleep and so remain naturally for several hours, while after nitrous oxide anesthesia he is likely to be kept awake by the pain in the wound unless morphia is administered. Bronchial irritation is not more common after ether anesthesia, if carried out as described heretofore, than after nitrous oxide anesthesia. If the plan of administering two ounces of castor oil twenty-four hours before the operation is strictly adhered to, there is almost no vomiting, no matter what anesthetic may be employed.

LOCAL ANESTHESIA OR ANALGESIA.

The use of nitrous oxide anesthesia is especially contra-indicated in conditions such as severe anemia, lowered or much increased blood pressure, diabetes, advanced nephritis, status lymphaticus, morbus Basedowi, Addison's disease, myocarditis, advanced cardiac and pulmonary disease. In these cases the use of local anesthesia should be considered.

There should be no doubt as to the extent of the operation, because the

anesthetic being limited to a local area, dragging of the tissue may affect other organs beyond the area of anesthesia. In some instances the administration of a local anesthetic may be more painful than the operation itself, and this would, of course, bar its use. All anesthetics have their disadvantages and dangers.

Consciousness a Disadvantage.

Consciousness during the operation is a great disadvantage to the operator unless he has the confidence of the patient. It is almost impracticable with many nervous individuals and children. In such the shock of apprehension may be greater than that which may result from the use of a general anesthetic.

Methods of Action.

Local anesthetics act in one of three ways, viz.: 1st, By producing an anemia of the capillaries supplying the nerve-endings. 2d, By direct action on the nerve-endings. 3d, By direct action on the nerve-fibres.

When about to perform an operation under local anesthesia all preparations should be completed before the patient is brought into the room. During the operation the patient's face should be covered, unnecessary conversation should be avoided and comparative silence should prevail. Stimulants should be at hand, and the patient should be carefully watched.

The chief object of this method is to produce anesthesia over a limited area, therefore a constricting band above the field of operation or the use of adrenalin are advisable, for, not only do they limit the field of action but they also diminish the amount of anesthetic required and the hemorrhage following.

Most Common Drugs.

The drugs most commonly used for the purpose of producing local anesthesia are cocaine, beta-eucaine, novocain, tropococain and ethyl-chloride. We have been in the habit of using cocaine for a number of years and to entire satisfaction.

Cocaine.

Cocaine when applied to the unbroken skin produces no effect. When applied to the mucous membrane or when injected beneath the skin it causes a tingling sensation, followed by a paralysis of sensation due to its toxic effect upon the nerve-endings. It also produces anemia from constriction of the capillaries, followed by hyperemia from secondary dilatation. The local action of cocaine is very brief, after which it is rapidly absorbed, and may produce constitutional symptoms.

At first the use of cocaine was limited to small areas, later the application of the constriction band above the field allowed more surface to be used so that more extensive operations could be performed. With the discovery of adrenalin, Braun suggested its use in combination with cocaine. The danger of the former method was that it only delayed constitutional symptoms. Adrenalin being a hemostatic diminishes hemorrhage, retards absorption and limits the action of the cocaine to a given area, consequently a less amount is necessary and the anesthesia is prolonged from one to three hours.

Preparation of Solution.

Cocaine hydrochloride is the preparation most frequently used. It is

soluble in chloroform, alcohol and water. In the preparation of the aqueous solution for surgical purposes, great care must be taken in the process of sterilization and in the avoidance of chemical contamination. Only a physiological salt solution in distilled water should be used. This is very important, otherwise intense burning sensation may follow its application. As cocaine loses its anesthetic property when brought to the boiling temperature (100 C.) sterilization may be accomplished by heating the solution at 80 C. for one-half hour on two successive days. After the solution is sterilized and the temperature reduced to blood-heat, an equal amount of a one to one thousand solution of adrenalin chloride is added. Adrenalin decomposes at boiling temperature. An air-tight metal or glass syringe is very essential. The needle is inserted just beneath and almost parallel with the epidermis in the direction of the line of incision. The solution is then slowly injected until an anemic area is produced into which the needle is gradually advanced, more solution being injected continuously. When the needle will not advance any further, it is withdrawn and the process then repeated. By injecting just beneath the epidermis the cocaine comes in direct contact with the nerve-endings and there is very little absorption.

Schleich's Infiltration Method.

In cases such as goitre and extensive lipomata in which a large amount of solution is required, this method is preferred.

Schleich employs three solutions containing 0.2 (strong), 0.1 (normal), 0.01 (weak) parts of cocaine hydrochloride, to which are added sodium chloride 0.2, morphine hydrochloride 0.025, and sterile distilled water sufficient to make 100 parts.

For this method a long needle is required. The solution is injected just beneath the epidermis and then into the deeper tissues about the diseased area. By this means anesthesia is partly produced by the cocaine and partly by the pressure of the water.

As much as 100 cc. of the weak solution may be used before the incision is made and later during the progress of the operation it is perfectly safe to inject up to 500 cc.

REGIONAL ANESTHESIA.

This method of anesthesia was first introduced by Braun and is of great practical value in certain operations which may be too extensive for the infiltration method and in which a general anesthetic is contra-indicated. This is especially true for operations on the extremities, but in order that it may be carried out successfully an accurate knowledge of the peripheral nerves is essential.

Where the peripheral sensory nerves are superficial, as in the hands and feet, the transverse circular or semi-circular subcutaneous infiltration of a 2 per cent. cocaine solution will render the skin below insensible to pain. This method is frequently employed for operations on the fingers and toes.

Perineural Method.

For the performance of operations on the extremities in which deep anesthesia is required, the injection of a 2 per cent. solution of cocaine and adrenalin about the nerve sheath will paralyze the nerve in from ten to thirty minutes, and anesthesia of the parts to which it is distributed will

last from one to three hours. This is known as the perineural method of anesthesia. No harm is done to the nerve and the shock which so frequently follows the section of a large nerve trunk is avoided.

Accessible Nerves.

The following nerves are accessible for this method:

The supra-orbital branch of the trigeminal just above the supra-orbital notch.

The ulnar behind the internal condyle of the humerus beneath the deep fascia where it perforates the internal intermuscular septum, also above the wrist beneath the inner side of the flexor carpi ulnaris.

The median just above the annular ligament of the wrist on the inner side of the palmaris longus.

The internal popliteal along the inner border of the biceps tendon behind the head of the fibula.

The occipital major as it passes through the outer border of the trapezius.

The auriculo-temporal as it passes backward and outward between the lateral ligaments of the temporo-maxillary joint and the condyle of the jaw close to the temporal artery.

The lingual at the point where the palato-glossal fold and the floor of the mouth meet.

The great auricular, occipital minor and the superficial cervical along the posterior border of the sterno-cleido-mastoid.

The superior laryngeal behind the cornua of the hyoid bone where it passes through the thyro-hyoid membrane.

The dorsal nerve of the penis in the region of the dorsal artery.

Endoneural Method.

It has been found that by injecting a 1 per cent. cocaine solution with adrenalin directly into the nerve trunk the same results may be obtained as with the perineural method. This is known as the endoneural method. The only advantage is that anesthesia is produced more promptly. The disadvantages are that it can only be used on large nerve trunks. The nerve must first be exposed and not infrequently does a neuritis follow. This method may be used on the crural, the sciatic and the brachial plexus.

Bodine and Cushing have introduced a method of anesthesia for hernia operations. They start the operation with the infiltration method and then inject the ilio-hypogastric and ilio-inguinal nerves as the operation progresses.

Intravenous Method.

The latest method of regional anesthesia is that which was introduced by Bier and is known as vein anesthesia. While as yet it is not generally accepted by the profession it is of some practical value and therefore worthy of mention.

It is only used for operations on the extremities.

The blood is first carefully expelled from the extremity by bandaging from the periphery toward the field of operation. A soft rubber bandage is then applied above the field so as to produce constriction over a broad surface. A second similar bandage is then applied below. A subcutaneous vein between the two bandages is then exposed and a weak solution of cocaine is injected toward the valves. Anesthesia usually follows in two to

fifteen minutes. The cocaine is dissolved in a physiological salt solution which penetrates the walls of the veins and acts on the nerve endings as well as the nerve trunks. The bloodless condition of the parts allows of very little absorption and a large part of the solution escapes from the wound, so that there is very little danger of constitutional symptoms. To further insure safety, Bier, before closing the wound, removes the peripheral bandage and loosens the proximal so that the arteries are open but the veins are still compressed. When the limb is pink and bleeds freely the tissues are thoroughly washed in order to remove as much as possible of the solution. The bandage is again tightened and the wound sewed up before anesthesia subsides. If a large amount of anesthetic has been used, Bier washes the vessels through a canula with physiological salt solution, which runs out through the wound. Bier refrains from using this form of anesthesia in senile or diabetic cases.

It may be used for operations on the extremities as a substitute for spinal anesthesia, being more simple and harmless.

SPINAL ANESTHESIA.

Spinal anesthesia was first introduced by Bier following the discovery by Corning, that cocaine when applied to a nerve trunk produces anesthesia of the region which it supplied.

Dangers and Disadvantages.

The mortality following this form of anesthesia is far greater than after ether, and therefore should only be used when the patient can not take the latter and when local or regional anesthesia is impracticable. It has no advantage over ether. The headache, nausea and retching which may follow its use may be more persistent than after ether, so that a spinal puncture may be required to relieve it. Collapse and even sudden death may occur during its application. Focal paralysis and even trophic disturbances may follow its use. With the introduction of newer methods of cocainization, its use is now practically limited to the upper half of the abdomen.

There is no pulmonary irritation. The patient being conscious may be able to aid the operator. There is complete muscular relaxation and no intestinal protrusion.

But it may fail in its purpose. Any accident during the operation alarms the patient and embarrasses the surgeon. In advanced cases of cardiac disease, the shock of apprehension may be worse than that from the operation itself. The operation must be completed within an hour and a half. Pelvic cases are unsafe unless the Trendelenburg posture is dispensed with. Spinal anesthesia cannot be stopped once it is started.

Injury to the spinal cord; hemorrhage into the subdural space; infection of the meninges, and anesthesia of the higher centers are the chief dangers.

The main object in the production of spinal anesthesia is to localize the action of the drug. In order to do this diffusion and gravitation must be overcome. The specific gravity of the spinal fluid is 1.007, therefore, a solution of greater or lesser specific gravity is safer, this depending on the position of the patient. The use of spinal fluid as a vehicle for the cocaine has been adopted with excellent results by Morton in hundreds of cases. To prevent diffusion a viscid substance, such as glucose, has been recommended.

This is quite unnecessary, although theoretically it looks attractive. Such a solution forms a stratum so that the action of the cocaine is concentrated at one point and being of greater specific gravity, gravitates to the most dependent part of the spinal canal.

The use of adrenalin retards absorption and prolongs anesthesia, but does not prevent diffusion so that the higher centers of the medulla may become affected.

Points of Injection.

The region in which the spinal puncture is to be made should be as carefully prepared as for any operation. The patient is placed in the sitting posture with the feet hanging over the side of the bed, or if unable to do this he should be placed on his side with the head elevated. For this procedure a good, graduated syringe with a long needle and stylet are required. The needle is inserted between the third and fourth, or the fifth and sixth lumbar vertebræ between the spines or the laminae. The former is preferred, there being less danger of injury to the cauda equina, and there is less liability of unilateral anesthesia. A needle with the opening on the side is to be preferred so that as soon as the needle enters the canal, fluid will appear. As soon as the needle enters the sac the stylet is removed and unless fluid appears, one is not certain that he is in the spinal canal. Two or three cc. of fluid are removed and from five to ten cc. of a one per cent. solution are injected. The strength of the cocaine solution does not seem to play a very important role in the production of anesthesia. Weak solutions act as well as the stronger depending on the pressure from the larger amount of solution used. The patient is placed in the inclined position with the head elevated according to the height of the anesthesia required. If the anesthesia is unilateral, he is gently rolled over on the other side. Elevation of the head is very important in order to prevent anesthesia of the higher centers. The head should not be lowered for several hours after the anesthesia has disappeared.

A 20 per cent. solution of magnesium sulphate has been recommended for the purpose of producing spinal anesthesia, but should not be employed owing to the alarming symptoms of respiratory depression that may occur. When injected into the blood sudden death may result.

Stovain and Strychnin.

General spinal analgesia by the use of stovain and strychnine, according to the method introduced by Jonnesco.

This plan has attracted so much attention that it seems proper to describe it at this point, although it has not as yet been in use sufficiently long to be so thoroughly established as to make it proper for me to recommend its use. For those who desire to test this method, however, the following paragraphs taken from Professor Jonnesco's article in the *British Medical Journal*, Nov. 13, 1909, give each step precisely as practised by its author, who has had, of course, by far the greatest experience in this direction up to the present time and who considers the method safe as compared with others. It is possible that the striking personality of this surgeon and his enthusiasm may be an aid in the results obtained by him.

Jonnesco's Own Description of Method.

There are two essential points of novelty in the method: (1) The puncture is made at a level of the spinal column appropriate to the region to be operated upon;

(2) anesthetic solution is used which, thanks to the addition of strychnine, is tolerated by the higher nervous centres. The selection of the anesthetic substance to be used will be determined by the surgeon's experience or confidence in any particular drug. I prefer stovaine, which has given me excellent results, and which I know how to manage; but tropacocaine or novocain are equally efficacious, and, thanks to the addition of strychnine, equally harmless.

1. *The Preparation of the Solution.*—The solution must be made at the time when the operation is to be performed as follows: The necessary quantity of stovaine, tropacocaine, or novocain is introduced into a glass tube provided with an india-rubber stopper, and sterilized in the autoclave. The substances need not be sterilized since they are themselves antiseptic, and some of their properties would be destroyed by heat.

The strychnine solution is made by dissolving 5 to 10 cg. of neutral strychnine sulphate in 100 grams of sterilized (not distilled) water in a glass-stoppered bottle previously sterilized; if 5 cg. of strychnine are used 1 c.cm. of the solution will contain $\frac{1}{2}$ mg.; if 10 cg., 1 c.cm. will contain 1 mg. The weaker solution is used for the upper, the stronger for the lower puncture. As the strychnine takes some time to dissolve, it is better to prepare this solution a little before the time when it has to be used. With an ordinary Pravaz syringe provided with a needle for lumbar puncture, 1 c.cm. of the solution of strychnine, a syringeful, is drawn up and is injected into the tube containing the dose of stovaine, judged to be necessary for the puncture about to be made. The tube is corked again, and shaken, and the salts are dissolved. The same syringe is then filled with the contents of the tube, and is held with a sterilized compress and removed from the needle while the puncture is being made.

2. *The Apparatus.*—This, as has already been indicated, is very simple, and within the reach of every surgeon in all circumstances, since it consists only of a common Pravaz syringe holding 1 c.cm., and the usual needle for lumbar puncture previously sterilized by boiling. The needle I prefer has a point cut rather squarely, for since the arachnoid space is relatively small, if the point of the needle be oblique, it is possible that part of the opening might go through the dura mater while part remained outside it. If this occurs part only of the solution penetrates into the arachnoid space, while a greater or less quantity is injected into the space between the dura mater and the osseous canal, and either analgesia is not produced at all, or it is incomplete; a result too often attributed to the insufficiency of the method or the idiosyncrasy of the patient.

3. *The Puncture.*—In my communications to the Congress at Brussels and to the Academy of Medicine in Paris, I indicated four points in the spine at which the puncture should be made in order to obtain analgesia of the region to be operated upon. I had already been convinced by experience that spinal anesthesia was not so regional as I had believed, and that medio-cervical puncture was as useless as it was dangerous. It favors the appearance of bulbar phenomena—nausea, vomiting, pallor of the face, faintness, momentary stoppage of respiration, and so on, phenomena due to a too direct action of the anesthetic fluid upon the bulb. Their occurrence may be avoided by making the puncture lower down between the first and second dorsal vertebræ, which produces as perfect and deep analgesia for the segment of the body comprising the head, neck, and upper limbs as is produced by medio-cervical puncture. Medio-dorsal puncture between the seventh and eighth dorsal vertebræ is very often difficult to perform, and is not necessary, for perfect analgesia of the lower segment of the thorax can be obtained by puncture made between the last dorsal and first lumbar vertebræ, which is easier to perform and produces also anesthesia of the whole lower part of the body.

I have therefore reduced sites of election for puncture to two—namely:

(a) *Upper Dorsal Puncture.*—Upper dorsal puncture between the first and second dorsal vertebræ is easily performed; the landmark is the vertebra prominens with the visible and tangible protuberances of the spinous processes of the second and third dorsal vertebræ. When the patient's head is strongly flexed, so that the chin touches the sternum, the protuberances are very marked, and the spaces they bound are enlarged. The patient being placed in this position, the surgeon marks with the forefinger of his left hand the space between the first and second dorsal vertebræ, and the needle, held between the thumb and forefinger and middle finger of the right hand, is pushed in, following the upper border of the spinous processes of the second dorsal vertebræ. For operations on the head, neck, upper limbs, and thorax the puncture should be made in this situation.

(b) *The Dorso-Lumbar Puncture.*—The dorso-lumbar puncture between the

twelfth dorsal and first lumbar vertebræ is very easily made, owing to the large space which separates the two spinous processes. I prefer this puncture to the classical lumbar puncture between the third and fourth lumbar vertebræ, because it produces more perfect analgesia of the whole abdomen and lower segment of the body. The space is easily found, for it is necessary only to count the lumbar spines upwards. The patient is seated with the thorax bent strongly forward, as in ordinary lumbar puncture. In making the puncture, the forefinger of the left hand marks the space, while the needle is pushed in with the right hand, following the upper border of the underlying spinous process.

In both cases the puncture is made in the median plane. Once the resistance of the skin has been surmounted, the needle must be pushed forward slowly, so as not to tear the tissues which are being transfixed. As a rule the needle enters easily as far as the dura mater, when a momentary resistance is felt; when this has been overcome, the flow of spinal fluid shows that the needle is in the right space. When the puncture is made at the high dorsal level, where the pressure of the cerebro-spinal fluid is diminished, it comes out drop by drop, whereas in the dorso-lumbar puncture it spurts out in a stream. This is the rule, but there are exceptions, for sometimes in the high dorsal puncture no fluid escapes; an effort of coughing will then usually suffice to make it appear, although it may be necessary to adapt a sterilized syringe to the needle in order to aspirate the fluid. If no fluid is thus obtained, the surgeon must conclude that his needle is not in the arachnoid cavity; the point of the needle must be disengaged, drawn back slightly, and pushed in again until the space is found. If the needle is introduced obliquely it may impinge on a lamina, but the peculiar sensation of having touched bone will warn the surgeon; he must then withdraw the needle completely and reintroduce it in the proper way—namely, in the median plane. If the fluid which escapes is blood-stained, it shows that a small vein has been transfixed—a matter of no importance, since the hemorrhage will soon cease spontaneously and the fluid become clear.

It is also possible to make the punctures with the patient lying on his right side, the head being strongly bent on the chest for the high dorsal puncture, and the thorax being bent forward for the dorso-lumbar puncture. This position should be preferred when the patient is feeble or very impressionable and cannot remain in the sitting position without risk of fainting; it must also be used if, an operation having lasted longer than was anticipated, a second puncture and injection to prolong the analgesia becomes necessary.

4. *The Injection.*—As soon as the escape of cerebro-spinal fluid renders it certain that the arachnoid space has been entered, its further loss should be stopped, for I am convinced that the escape of more than a certain quantity of fluid is rather harmful than useful. The loss of too much fluid (1) may cause signs of faintness, pallor of the face, sweating, etc.; and (2) by suddenly diminishing the quantity of cerebro-spinal fluid may cause too rapid diffusion of the anesthetic, which is undesirable and may be mischievous. As soon, then, as a few drops of fluid have escaped, the needle is closed with the forefinger of the left hand, while with the right the syringe filled with the anesthetic mixture is adapted to the needle. The liquid must be slowly injected so as not to produce an undue impact upon the spinal cord.

5. *Position of Patient after Injection.*—The position to be assumed by the patient after the injection, so as to ensure analgesia of the region to be operated upon, is a cardinal point, for by attention to it we can favor the distribution of the liquid in the desired direction. If with the higher dorsal injection it is desired to obtain analgesia of the head and neck, the patient is made to lie on his back; if the operation is to be on the throat, the head should be a little raised; if on the face or skull, he should lie horizontally; if on the upper limb or the thorax, he should remain sitting for two or three minutes, and then lie on the back with the head, neck and thorax bent slightly forward. If after four or five minutes the analgesia of the head or of the neck is not complete, the patient's head should be lowered below the level of the body for three or four minutes.

With dorso-lumbar injection if the viscera of the upper abdominal region (liver, stomach, spleen, pancreas, kidneys, etc.) are to be operated upon, the patient must remain in the sitting posture for two or three minutes, and then lie on the back, the head, neck, and shoulders being raised. If after five or six minutes the analgesia is incomplete, the patient must be inclined (Trendelenburg) for a few minutes, three or four, after which he again returns to the sitting posture. If the operation is on the lower abdominal region (pelvis, perineum, external genital organs) or on the lower limbs, the patient should remain in the sitting posture for five or six minutes,

and then lie on his back, with the upper part of the body, head, neck, and thorax raised and bent forward.

6. *The Dose.*—The amount of stovaine and strychnine in the anesthetic mixture should vary with the site of the injection, the patient's age, and his general condition. I confine my remarks to stovaine, as it is the drug with which long practice has made me familiar, so that I can administer it with precision and safety. I cannot speak with equal confidence of other anesthetics, such as novocain and tropacocaine, with which I have had little experience.

Strychnine.—The variation in the quantity of strychnine is not relatively great. For the higher dorsal injection I employ: For children of from 1 to 5 years $\frac{1}{8}$ mg. in 1 c.cm. The solution is made by dissolving $3\frac{1}{2}$ cg. of neutral strychnine sulphate in 100 grams of sterilized water. For children above 5 years, for adolescents, adults, and aged people the solution contains $\frac{1}{2}$ mg. of neutral strychnine sulphate in 1 c.cm., and is made by dissolving 5 cg. of the strychnine salt in 100 grams of sterilized water. For dorso-lumbar injection, for children from 1 to 10 years old, I use a solution containing 1 mg. of strychnine in 1 c.cm.; for children above 10 years, adolescents, adults, and old people, a solution containing 1 mg. in 1 c.cm., made by dissolving 10 cg. of the neutral strychnine sulphate in 100 grams of sterilized water.

Stovaine.—The amount of stovaine varies with the site of the injection, the patient's age, and his general condition. For the higher dorsal injection I use for children from 1 to 5 years old, 1 cg.; from 5 to 15 years, 2 cg.; for adolescents, adults, and aged people, 3 cg. For the dorso-lumbar puncture, for children from 1 to 5 years, 2 to 3 cg.; from 5 to 15 years, 4 to 6 cg.; for adolescents from 15 to 20 years old, 6 to 8 cg.; and for adults and aged people 10 cg. The dose of stovaine must also be adapted to the general condition of the patient. In persons who are consumptive, very anemic, who are suffering from auto-intoxication or grave infections, or who have suffered severe injury, or are ischemic owing to profuse hemorrhage, 5 or 6 cg. of stovaine produce deep and prolonged analgesia, and larger doses are badly tolerated, causing pallor of the face, nausea, vomiting and transient faintness.

In order to be able to judge of the degree of the diffusibility of the liquid injected into the arachnoid cavity the specific gravity of the solution of strychnine and stovaine compared with that of the cerebro-spinal fluid must be known. The average density of cerebro-spinal fluid is 1,003, but it varies from 1,003 to 1,020. Dr. Hancu, Chief Pharmacist to the Coltza Hospital, has found that the following solutions have the specific gravity stated:

	Grams.	Sp. gr.
1. Strychnine	0.05	
Stovaine	2.00	1,0019
Water	100.00	
2. Strychnine	0.05	
Stovaine	3.00	1,0030
Water	100.00	
3. Strychnine	0.10	
Stovaine	6.00	1,0071
Water	100.00	
4. Strychnine	0.10	
Stovaine	8.00	1,0105
Water	100.00	
5. Strychnine	0.10	
Stovaine	10.00	1,0120
Water	100.00	

The solution used for injection in high dorsal puncture (containing 3 cg. of stovaine and $\frac{1}{8}$ mg. of strychnine) has a specific gravity equal to or greater than the average density of cerebro-spinal fluid; this fact explains the rapid diffusion towards the cervical part of the cord and the cranial cavity, which, as will be shown later, takes place if the injection is made here, and also the readiness with which analgesia is produced. The solution used for injection in the dorso-lumbar puncture has, on the other hand, a specific gravity greater than that of cerebro-spinal fluid, and the larger the quantity of stovaine the higher the specific gravity. In this situation the

diffusion of the solution takes place slowly, a fact which explains the relative delay in the production of the analgesia, and partly also the harmlessness of the Trendelenburg position, the solution tending to remain in the lower parts of the arachnoid cavity.

Phenomena Observed During Analgesia.—With the higher dorsal puncture the analgesia is, for the reason just stated, usually complete in two or three minutes. On the other hand, after dorso-lumbar injection, analgesia is produced more slowly, but is complete in at most ten minutes. If analgesia is not obtained within this time, it is evidence that the solution has not reached the arachnoid cavity, or has reached it in too small a quantity, and the puncture and injection must be repeated. It is a mistake to attribute failure to produce analgesia to idiosyncrasy. It is true that I have seen some cases in which after puncture followed by a flow of cerebro-spinal fluid no analgesia has been produced, but a second, or in some cases a third injection of the same dose of the anesthetic has produced complete analgesia. It is tempting to suppose that these patients were refractory to normal doses and required larger doses, but this is a mistake; no patient could support 20 to 30 cg. of stovaine and 2 or 3 mg. of strychnine without presenting marked bulbar phenomena—stoppage of breathing and of the heart—attributable to the excess of stovaine. The occurrence must be otherwise explained. It is to be attributed to an untimely movement of the patient at the moment of the injection, very trifling, perhaps, in appearance, but sufficient to displace the point of the needle already engaged in the arachnoid cavity. Owing to the slight and imperceptible displacement the orifice of the needle is withdrawn partly or wholly from the cavity, and the solution is therefore injected in part or in whole outside the cavity, between the dura mater and the osseous canal.

In one case of high dorsal puncture I only obtained analgesia after a third injection—that is to say, after using 9 cg. of stovaine and $1\frac{1}{2}$ mg. of strychnine, doses which no patient could support without showing bulbar phenomena. It is certain, therefore, that only the third injection penetrated the arachnoid cavity. In another case of dorso-lumbar injection, in a patient in whom on a previous occasion excellent analgesia was obtained with 6 cg. of stovaine, 16 cg. in two injections failed to give any result, and it was only after a third injection of 6 cg. that analgesia was produced.

During analgesia patients retain full consciousness, and I am in the habit of speaking to them to divert their attention from the operation, of which the majority are unaware, the operating field being hidden from them by a cloth supported by two bars attached to the operating table at the level of the neck. I prefer this cloth to a mask, which is embarrassing to the patient and a great trial to his patience during a long operation. A patient may be heard to ask after an operation is finished when it is to be begun.

The immobility of the limbs, the neck, and the head, due to paresis caused by the spinal analgesia, is a great advantage to the surgeon by suppressing movements which might embarrass him. It is true that there may be complete anesthesia without loss of mobility in the limbs; this rarely happens, but its occurrence ought to be known, as it is not necessary to wait for paresis before beginning to operate.

After dorso-lumbar injection the abdominal viscera, including the intestines, are immobile, and this "abdominal stillness" is a great advantage, especially in gynecological laparotomies. The viscera are, as it were, congealed, are not stimulated by any fit of coughing or effort of vomiting, and therefore do not obstruct the field of operation, as happens so often with inhalation anesthesia.

The occurrence of such phenomena as pallor of the face, nausea, or sweating, so often observed when spinal analgesia is produced by the injection of stovaine, tropacocaine, or novocain is seen only exceptionally when the stovaine and strychnine solution is used. The face retains its normal aspect; nausea occurs in 2.25 per cent; vomiting—a single effortless ejection—in 1.25 per cent; and sweating in 2 per cent. In some cachectic, feeble individuals I have observed fecal incontinence (4 per cent). The pulse, which is slowed in spinal analgesia produced by stovaine alone, is, when the stovaine and strychnine solution is used, usually normal in rapidity and strength. Sometimes it rises to 80 to 90, but always remains strong. These facts prove the powerful influence of the strychnine in neutralizing the depressing action of the stovaine. Under certain special conditions I have in 5 cases observed momentary stoppage of respiration; in 3 of these cases I had used for medio-cervical puncture a solution to which atropine $\frac{1}{2}$ mg. had been added. I have abandoned both the use of atropine and puncture in this situation. In one other case I had used for high dorsal injection 4 cg. of stovaine, too large a dose, as subsequent experience has proved. In the fifth case dorso-lumbar puncture had been preceded by subcutaneous injection three and a half hours before operation of scopolamin and morphine. In this case, as I had

feared in view of the poisonous effects of so powerful a drug as scopolamin, the respiration stopped, and was only re-established after fifteen minutes. None of these accidents can be attributed to the method that I have here described, but to departures from it which ought to be avoided.

Duration of Analgesia.—The analgesia, when the anesthetic is administered in the manner described, lasts from one and a half to two hours, a period longer than is necessary to perform any operation. I should add for the benefit of surgeons inexperienced in spinal analgesia, that though the condition may be obtained with less than 3 cg. of stovaine in high dorsal puncture, and less than 10 cg. in the dorso-lumbar puncture, the anesthesia is neither so deep nor so durable. With 8 cg. analgesia may be produced, but the patient preserves sensation of contact and of traction on the viscera, or on the sides of the wound. With 10 cg. all sensation is abolished; for this reason there should be no hesitation in using doses which may seem large but which are harmless and produce complete anesthesia. If an operation has lasted so long that the analgesia passes off, I make another puncture with the patient in dorsal decubitus, and in this way analgesia can be prolonged as long as may be necessary without inconvenience. This dose used for the second injection should be either equal to that given in the first or smaller, according to the probable duration of the operation.

Phenomena After Analgesia.—Headache, retention of urine, and a rise of temperature, frequently observed when spinal analgesia is produced by stovaine alone, are seldom noted, and are of short duration when the method here described is followed. Headache has been observed in 6.25 per cent, but is not severe and disappears in a few hours. Transitory retention of urine was observed in 4.5 per cent, but only in those operations in which it is also produced with inhalation anesthesia, such as those on the anus, the uterus, and for hernia. In no case did the temperature reach 40° C. (104° F.); a temperature as high as 39° C. (102.2° F.) was observed on the evening of the day of operation in 1.75 per cent; of 38° C. (100.4° F.) in 16 per cent; of 37° C. (98.6° F.) in 50 per cent. Post-operative vomiting has rarely been observed, and I have never seen post-analgesic paralysis.

Conclusions.—1. The fundamental principles in spinal analgesia are that puncture of the arachnoid may be performed at all levels, and that to the anesthetic whether stovaine, tropacocaine, or novocain, strychnine should be added.

2. Puncture of the arachnoid at whatever level is harmless, and the fear of pricking the cord unfounded; even if it happens it is not harmful.

3. Medio-cervical puncture is useless and dangerous; mid-dorsal puncture is difficult and useless; superior dorsal puncture between the first and second dorsal vertebræ, and dorso-lumbar between the last dorsal and first lumbar vertebræ are easy, and suffice to obtain analgesia of all regions of the body.

4. The addition of neutral strychnine sulphate to the anesthetic preserves the full antiseptic power of the solution and at the same time neutralizes its injurious action upon the bulb. Thanks to this addition, superior spinal analgesia can be performed without danger.

5. Among known anesthetic substances, stovaine, tropacocaine, and novocain seem to be the best; any of them may be used with the addition of strychnine.

6. The strychnine and the anesthetic substance need not be sterilized, a process which would destroy some of their properties.

7. The water used for making the solution must be sterilized but not distilled.

8. The injection should consist of 1 c.cm. of solution, the amount of strychnine and anesthetic substance being varied.

9. The technique is simple, requiring only a Pravaz syringe and the usual needle for lumbar puncture.

10. There are no contraindications for general spinal anesthesia, which always succeeds if the liquid penetrates into the arachnoid cavity and if the dose of the anesthetic is sufficient.

11. General spinal anesthesia is absolutely safe; it has never caused death, nor produced any important complications, early or late.

12. General spinal anesthesia is infinitely superior to inhalation anesthesia. Owing to its simplicity, it is within the reach of all, and as there is no contraindication it may be employed with any patient. As it can be performed by the surgeon himself it does away with the attendance of a person often inexperienced, and never responsible.

13. In operations on the face, or the throat, where analgesia by inhalation is difficult and often incomplete, spinal analgesia is a great resource. In laparotomies, owing to the "abdominal silence" it determines, it is very much superior to analgesia by inhalation.

14. The facts stated in this paper will prove how in science a condemnation *a priori* like that pronounced by Professors Bier and Rehn is precipitate and ill-founded.

15. I am firmly convinced that general spinal analgesia will be the analgesic method of the future.

Ethyl Chloride.

This substance is very volatile and when applied to the skin evaporates rapidly, producing a great amount of cold. As a general anesthetic its use is limited to short operations and except in the hands of an expert it is associated with great danger. Its advantages over ether are the brief period of excitation, the prompt return to consciousness, and the absence of disagreeable after effects. Locally, it can only be used where a single incision is required and for the introduction of aspirating or transfusion needles. It is sponged upon the surface until the skin is frozen into a hard white mass, then the slight operation is performed before the heat of the body and the temperature of the room have thawed out the frozen skin. The after-pain is rather more severe than in case of general anesthesia, but as the wounds are always small, this is of no great importance.

A Ready Freezing Mixture.

The same end can be accomplished by placing equal parts of chipped ice and table-salt in a piece of sterile gauze of about four thicknesses and holding this for about one minute directly upon the area which is to be incised or punctured. This will freeze the skin quite as effectively as the ethyl chloride spray. The gauze may be moistened with a one to 2,000 solution of corrosive sublimate in order to ensure antiseptic conditions. This, however, is not necessary, because clean table-salt and clean ice are both sufficiently free from pathogenic micro-organisms to make their use, as described above, safe.

Scopolamin and Morphin.

We are firmly convinced that the use of scopolamin with morphin for the purpose of anesthesia is to be warned against. It is a very powerful drug combination, different preparations of which vary in activity. Confusion and violent delirium may follow its administration. We have employed this method sufficiently often to be convinced that it is much more dangerous than ether anesthesia by the drop plan. In cases in which it seems indicated, we greatly prefer to give morphine, one-sixth to one-third grain, with atropine one one-hundred and fiftieth to one-hundredth grain, hypodermically, half an hour before beginning the administration of the anesthetic.

Various modifications of the original plan of using scopolamin and morphine have been suggested and other drugs like hyoscin have been substituted, but the effect is the same. If used in small quantities they seem no more efficient than morphine alone, and when used in large quantities they appear much more dangerous.

RECTAL ANESTHESIA.

The advantage of this method must be apparent if further experience does not show harmful effects.

Advantages Claimed.

The following advantages are claimed by those who have employed it.

1. The amount of ether used is very much smaller than by inhalation method.
2. There is no stage of excitation.
3. There is no irritation of the respiratory mucous membranes.
4. The anesthetist does not approach the field of operation.
5. Besides being out of the way he also is unable to infect the wound.
6. The patient awakens almost at once after the anesthetic is stopped.
7. There is said to be less nausea and vomiting, probably because the patient has not swallowed quantities of mucus saturated with ether.
8. There is no depressing effect upon the heart.

It is, however, to be remembered that all of these advantages are also obtained if the method is employed which has just been described of thoroughly anesthetizing the patient by inhalation and then stopping the anesthetic and elevating the head during the operation.

Method of Application.

It is in the first place most important that the colon be empty at the time of administration of ether by rectum, because the presence of feces will prevent the rapid absorption of ether and the openings in the tube through which the ether fumes are introduced may become clogged and thus the introduction in sufficient quantities of the anesthetic may be prevented.

In order to secure an empty colon two ounces of castor oil, preferably in beer foam, should be given twenty-four hours before the operation; twelve hours later the patient should receive a large cleansing enema of soap suds and normal salt solution and this enema should be repeated three hours before the operation. In the meantime no food should be given except broths and gruels, in order that there may not be any fresh intestinal accumulation.

The patient is placed upon the table, the surface of the neck thoroughly prepared and then covered with a piece of sterile gauze saturated with alcohol. The hair is covered and a gauze pad is placed across the mouth and nose as described previously, in fact the preliminary preparation is identical with that employed if the operation is to be performed under ether anesthesia by inspiration. An assistant also draws the lower jaw forward and holds it in that position throughout the operation.

An ordinary soft rubber rectal tube with an opening at the end is then slowly introduced into the rectum a distance of eight or ten inches. The tube should be thoroughly lubricated in order to prevent annoyance by friction. The gas contained in the rectum is thus permitted to escape in order to facilitate the absorption of ether. The rectal tube is then attached to the tube through which the ether fumes are pumped into the rectum. The colon is then slowly filled with ether fumes and then the rectal tube is once more disconnected in order that any remaining intestinal gas which was not evacuated primarily may escape. This procedure may be repeated several times, care being taken that the ether fumes are not injected too rapidly for fear of too great distension or irritation. At first some gas may escape along the side of the rectal tube, but this can soon be prevented by injecting only just enough gas to fill the colon. There may be slight colicky pains at first, but the patient will soon become accustomed to the sensation. If the castor oil and the enema have acted satisfactorily, there will be no annoyance from defecation or clogging of the rectal tube. The full anesthesia will occur in

from five to fifteen minutes, and the operation can be performed with the consumption of from one to three ounces of ether.

When the operation is completed to the point of suturing the external wound, the apparatus is detached from the rectal tube and the accumulated gas in the colon will thus be permitted to escape. If the patient is slightly conscious of the application of the skin sutures, the consequent deep breathing will facilitate the excretion of most of the ether contained in the blood through expired air. It also facilitates the expulsion of any ether fumes which may still remain in the colon. This can be further favored by making gentle abdominal massage.

The patient must be observed throughout the period of administration with the same care as when ether is given through the respiratory tract. Cyanosis will almost never occur if the lower jaw is held forward as stated. The pulse and respiration will indicate the progress of the anesthesia. It is rarely necessary to disconnect the rectal tube from the apparatus and to make abdominal massage to force the ether fumes out of the rectum during the operation, but in case of necessity this could be readily done. If the head is elevated after the operation is begun, almost no anesthetic will be required during the actual progress of the operation.

Apparatus.

Various forms of containers have been invented for producing the ether fumes utilized in this form of anesthesia. A simple, deep bottle constructed on the general plan of wash bottles used in chemical laboratories seems to suffice perfectly if mounted on a stand which can be easily moved without breaking the bottle or its attachments. The bottle should be fitted with a rubber stopper with two holes, one of which contains a glass tube whose lower end is even with the stopper and whose upper end is attached to a rubber tube which in its turn is fastened to a glass tube for attachment to the rectal tube. The other hole contains a glass tube with bulb-shaped lower end containing many small perforations and reaching to the bottom of the bottle. The upper end of this tube projects through the upper surface of the rubber stopper a sufficient distance to permit the attachment of a rubber tube the other end of which is attached to a bulb with which air can be forced into the bottle. The bottle should be at least thirty centimeters deep so that the air can be forced through a considerable column of ether. The bottle is filled with ether to a point five cm. from the lower surface of the cork, the upper portion of the bottle being left as a gas space.

This bottle should be immersed in a vessel containing water at a temperature of from 80 to 100 degrees F., according to various clinicians, the boiling point of ether being 98.8 degrees F. A thermometer is to be placed in the water and a stopcock at the lower part will make it possible to remove the water when the temperature has become too low.

According to another method, which has also been frequently used and apparently with equally satisfactory results, the arrangement for blowing through the ether is dispensed with; a simple flask being employed containing a rubber cork fitted with a glass tube whose lower end is even with the lower end of the rubber stopper. To the upper end of this a glass tube is attached which in turn is attached to the rectal tube by means of an intervening glass tube. Some surgeons prefer to have this attachment made by means of an intervening rubber tube which is fitted with a stop-cock so that

the flow of the ether fumes may be interrupted at any time. The flask containing the ether is then immersed in a water-bath at a temperature of 105 degrees F., which will cause ether to evaporate with sufficient rapidity to bring about the anesthesia. In case the amount evaporated is not sufficient, the temperature may be increased. If the evaporation is too rapid, the flask may be raised out of the water-bath either partly or completely until it again becomes desirable to increase the amount of ether fumes.

The procedure is so simple that any one who has seen it applied once can readily administer ether in this way, but it seems worth while to be explicit in a description because it has not as yet received practical application to a sufficient extent to become familiar by demonstration. By substituting a good-sized thermos bottle for the container of the warm water, with a rubber cork that fits closely around the upper end of the bottle containing the ether, the apparatus can be still further improved because the water will then maintain a fairly uniform temperature throughout the operation and the slight decrease in temperature will be rather an advantage than otherwise.

INCISIONS.

Rules Ignored in Malignant Growths.

In making incisions it is important in the first place to bear in mind the fact that in operating for the removal of malignant growths all rules concerning the direction and extent of incisions may be disregarded if by regarding them there is the slightest danger of leaving any portion of the growth in the body of the patient. In a very large proportion of patients that have come under care in an inoperable and hopeless condition from the recurrence of a malignant growth, some timid surgeon has made the first removal with a view of obtaining a satisfactory cosmetic result. Had the first excision been bold without regard to the necessary deformity, many of these patients would have been permanently relieved by the first operation. For this reason it seems wise to insist at this point on disregarding cosmetic conditions absolutely when they interfere to the slightest degree with thoroughness in dealing with the removal of malignant growths.

In all other cases there are eight conditions to be borne in mind.

Eight Rules of Guidance.

1. The skin incision should be made in a manner to correspond with the natural folds in order to be as little apparent as possible after healing has taken place. Careful inspection of the surface will always suggest position and direction of the incision, so as to result in the least degree of deformity for the amount of disturbance required by the operation.

2. The underlying anatomical structures must be considered. Of these the important nerves and the large blood vessels are to be heeded; the former because if united after having been once severed, ideal results are not usually obtained; the latter because of the danger of post-operative gangrene or edema in the extremities and of serious cerebral disturbances in case of section of the large vessels in the neck.

3. At points where muscles, aponeuroses or fascia are needed to support important parts, as in the abdominal wall, it is wise to plan all incisions so that the object of the operation may be accomplished and the structures separated so as to secure a fair amount of space for performing the various steps of the operation and still to have muscles and fascia separated or split

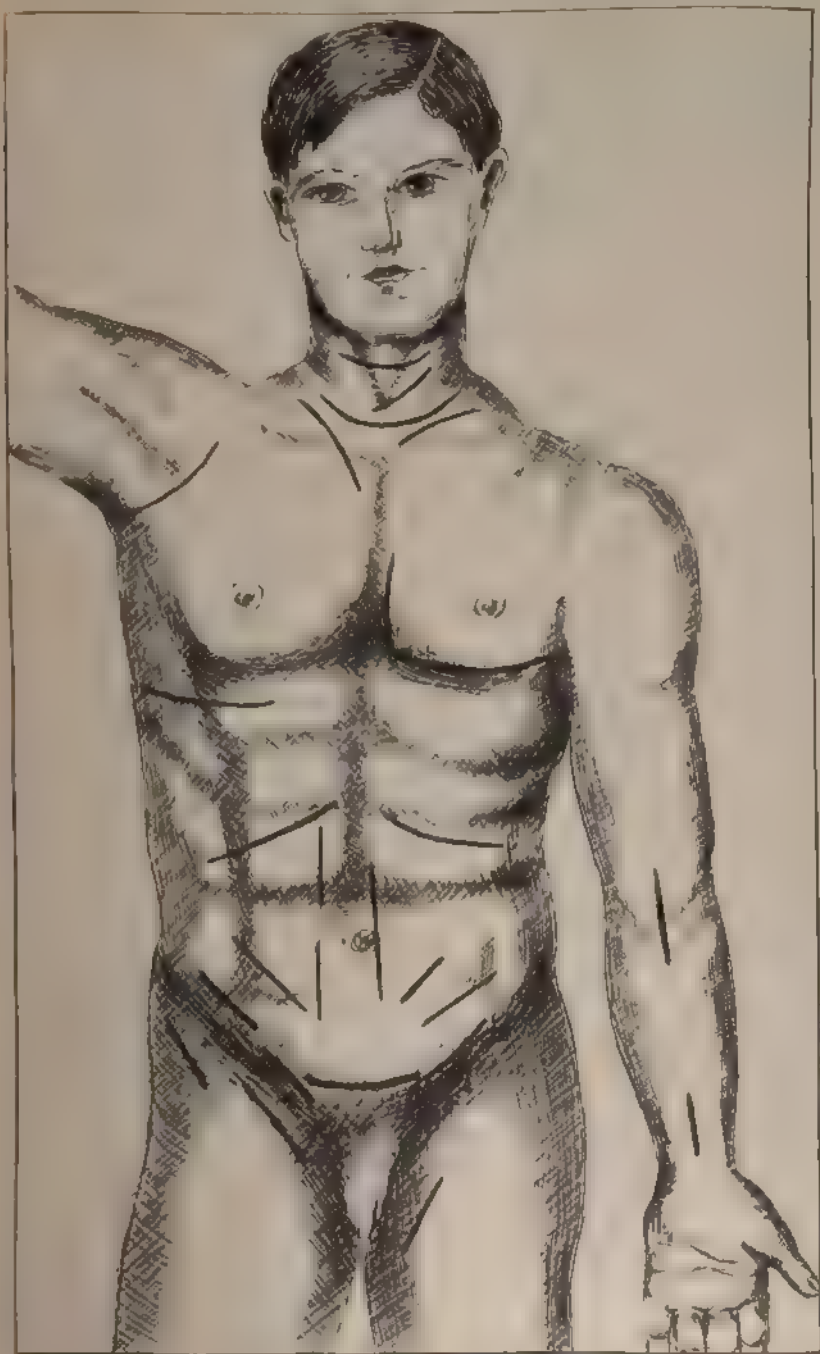


Fig 3
Anterior Incisional Lines

rather than cut at right-angles, in order that when the operation itself has been completed these separations or splittings may be repaired and thus the conditions at the conclusion of the operation, so far as the tissues are concerned through which it was necessary to secure entrance, may be as nearly as possible the same as they were at the beginning of the work.

This plan has the further advantage of making it possible to avoid injuring nerves and blood vessels of importance in the region of the operation because these usually lie in the direction of and parallel to the muscles.

4. In portions of the body in which the surface is exposed, as in the neck and face, symmetry should be attained as much as possible. In many instances, as in operations upon the forehead, the nose, the lips, the chin or the neck, a one-sided incision will result in much deformity when an incision extending over both sides, resulting in an equal amount of exposure of underlying tissues, will cause but a slight amount of deformity.

5. It is important to bear in mind the occupation of the patient. Future usefulness may be of so much greater value to the patient in many instances than personal appearance that the latter may be practically disregarded, while in other cases quite the opposite may be the case.

6. It is important to plan incisions so that they will not become painful later, because of pressure or because of the motion of contiguous joints.

7. Wherever it is possible to hide scars under the natural covering of hair, as in the region of the eyebrows or the male beard, it is well to take advantage of these structures.

8. But while considering all of these features, it is important not to lose sight of the fact that the incision must be so planned as to expose the diseased structures to be treated during the surgical operation so that this treatment can be carried out to the best advantage of the patient.

In a general way the incision should be made in the direction of the muscles, nerves and blood vessels.

An Exceptional Rule.

There is one exception to this rule in exploring for needles or other thin objects that are buried in the tissues and that have been located by the use of skiagrams. It is practically impossible to find these foreign bodies unless the incision is made at right-angles to the object. Of course, if the needle lies parallel to arteries and nerves then the transverse incision will also be at right-angles to these structures which must be carefully found and retracted to one end of the incision while the latter penetrates into the depth beyond.

We have repeatedly been able to locate needles buried in the deep tissues in a few moments in cases in which a search of more than an hour had failed to locate the foreign body previously, because this was attempted through an incision parallel or nearly parallel to the foreign body.

The only structures that need be considered in these instances are the nerves and the blood vessels in case the latter are of any considerable size, and also the tendons. Muscle, fat, skin and fascia may be severed and re-united with catgut sutures.

Surface Incisional Lines of Choice.

The choice of location and direction for these incisions has been carefully worked out by many surgeons and anatomists. The scheme developed

by Professor Sanger, slightly modified to suit our clinical work, has seemed most simple and still sufficiently comprehensive to be entirely satisfactory.

Figs. 3 and 4 represent the lines on the anterior and Fig. 5 on the posterior surface of the body.

There is a marked advantage in choosing these lines not only from the fact that one can obtain convenient access to the underlying structures, but also from the fact that in these locations one can safely make the incision sufficiently large to obtain a free view of the tissues to be considered in the operation. It is a mistake to perform operations through incisions which are too small for fear of producing deformity from making a larger external wound, because if these locations are chosen in a position and direction which is anatomically correct, there is no danger of obtaining ugly scars as the underlying muscles will not distort the resulting cicatrix, and these wounds heal without leaving any considerable deformity. In fact in many instances it is difficult to recognize the scar after a few years.

Separation of Deep Structures.

It is, however, quite as necessary to study the best manner of separating the deeper tissues as it is to choose properly the position and direction of the external wound. Here again it is important whenever possible to separate the muscles instead of cutting them. Small arteries and veins may be disregarded. Large blood vessels should be protected, not only against direct injury but also from crushing by the use of retractors, because this undoubtedly often causes phlebitis or thrombosis after surgical operations.

The special details concerning incisions will be fully considered in connection with each individual operation.

HEMOSTASIS.

Conserve the Blood.

It is important to secure prompt and efficient hemostasis during surgical operations, because there is a direct relation between the degree of shock and the amount of blood lost by the patient. Whenever it is possible to isolate blood vessels, to clamp them doubly by applying two pairs of hemostatic forceps to cut between these and to ligate the proximal end, one has obtained ideal conditions.

In many operations this plan can be carried out to such an extent as to practically prevent loss of blood altogether. Ordinarily, this is of no importance in itself, because most patients can bear the loss of a fair amount of blood without harm, but hemostasis also keeps the tissues clearly exposed so that the anatomical relations can be kept perfectly in view constantly during the operation. This not only facilitates the work, but makes it possible to suture the tissues with all of the structures in their normal relations, leaving the completed operation more perfect than it would be had the field been constantly obscured by being saturated with blood.

Some surgeons have carried this idea to a foolish conclusion. They have insisted upon catching even the smallest vessels with hemostatic forceps and ligating each vessel separately, thus consuming several times as much time as necessary in performing the operation. We have seen a patient kept under an anesthetic for a period of four hours, at least three of such hours being consumed in ligating small vessels which would have ceased bleeding within a few moments without causing any harm to the patient whatever.

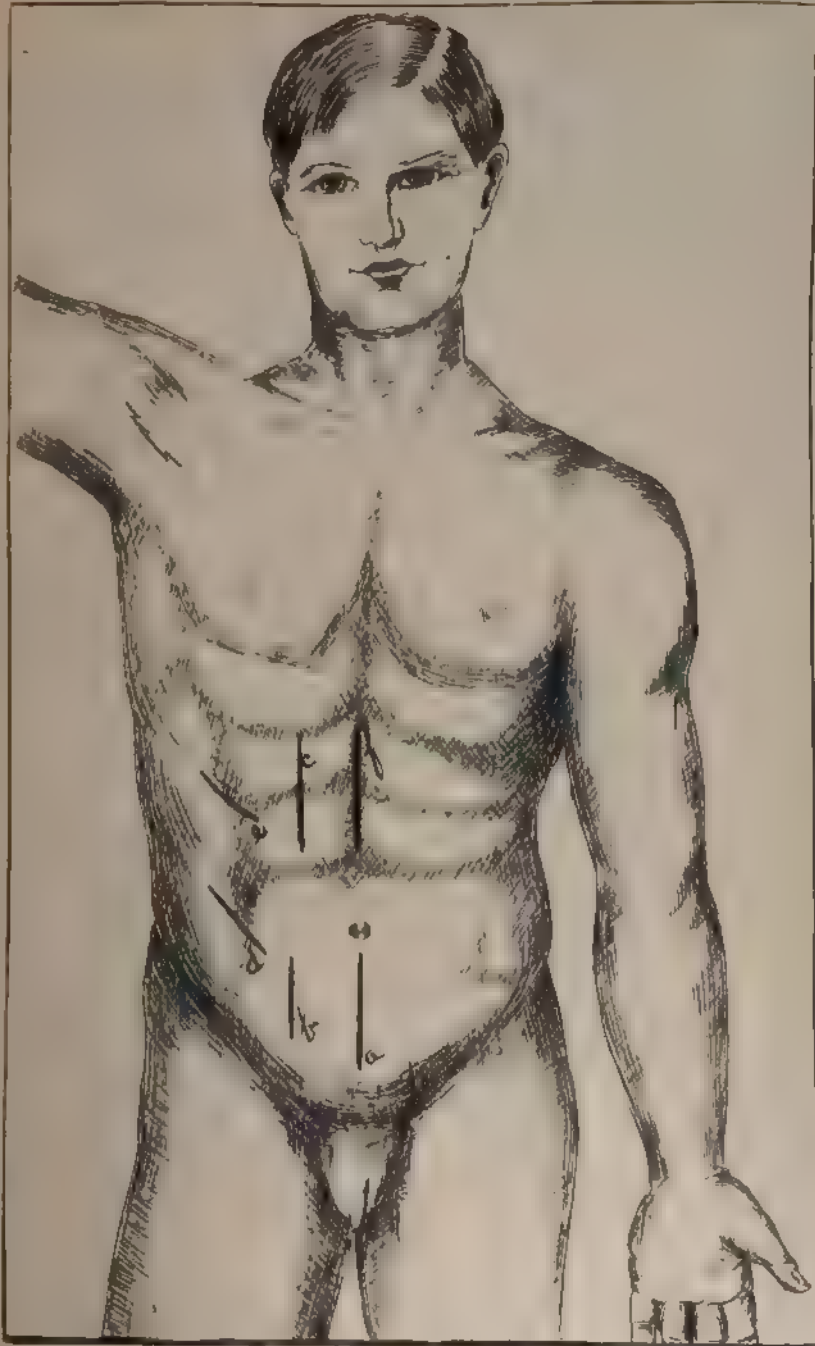


Fig 4

Anterior Abdominal Incisional Lines

On the other hand it is quite as bad to be reckless about the loss of blood for such disregard is certain to result in the death of a patient occasionally.

It is wise to use strong-jawed hemostatic forceps which will crush the end of the blood vessels of medium and small size. These may be left in place until the operation has been completed when only the large vessels need to be ligated, the crushing having permanently closed the smaller vessels.

It is well to bear in mind that the surface of the wound should not be rubbed with sponges or gauze pads after these forceps have been removed, because this often opens up blood vessels which would otherwise remain closed permanently.

TORSION OF BLOOD VESSELS FOR HEMOSTASIS.

Before it was possible always to obtain perfectly sterile, absorbable ligatures the method of grasping blood vessels with hemostatic forceps and twisting them in order to permanently occlude the bleeding point had obtained many adherents. It is reasonable that this should be so. Many surgeons applied this method to vessels as large as the brachial or the popliteal artery. Although this can be done safely in most cases, it would be foolish to make use of this method in any of the larger vessels at the present time, because it is not as dependable as ligation and the latter is quite as safe always and has no disadvantages over the former.

CRUSHING AND APPLICATION OF HEAT.

Several years ago many instruments were invented for the purpose of crushing large blood vessels with an enormous force applied to the jaws of the forceps by means of levers or screw arrangements. These instruments are now temporarily obsolete, but they are certain to be readvised from time to time, although there is no longer any real need because of the fact that ligation with catgut ligatures is more convenient and in every way equally satisfactory and somewhat more reliable even in the hands of surgeons who use the crushing forceps with the greatest care and patience.

Moreover the ligature saves time because the crushing forceps must be left in position at least for a period of one minute in order to make their use fairly safe. For the average surgeon these powerful crushing forceps are not safe because he will not exercise the necessary care in applying them, nor patience to leave in place the necessary length of time. It is quite a different matter from the use of the strong-jawed hemostatic forceps mentioned above as these can be left attached to the smaller blood vessels while the operation proceeds.

Heated Clamps.

Dowd has invented a clamp containing a coil of platinum wire for the purpose of heating the jaws of the instrument by passing a current of electricity through the coil.

The clamp is applied to a mass of tissue, like a broad ligament, then its jaws are isolated from the surrounding tissues by a metal shield whose construction makes it a poor conductor of heat, then a current of electricity is passed through the forceps sufficiently strong to heat the blades so that

the stump will be thoroughly boiled for twenty to forty seconds. The current is then turned off and the stump is cut beyond the clamps when the latter are removed. In order to prevent the jaws of these clamps from adhering to the cauterized stump they are thoroughly covered with sterile olive oil before being applied.

The method is perfectly satisfactory but it seems indicated only in cases in which the portion beyond the pedicle contains malignant tissue, as for instance in case of removal of uterus, ovaries, and for the cure of carcinoma of the uterus. In ordinary operations the method is in no way to be preferred to the use of the catgut ligature.

In the removal of organs containing malignant growths the cauterization of the stump may prevent recurrence in cases in which there may be invasion extending into but not beyond the stump.

LIGATURE MATERIAL.

Catgut Ligature the Best.

Catgut prepared according to the methods already described is an ideal ligature material because it has great tensile strength, it is absolutely free from septic germs or spores, it is thoroughly filled with minute crystals of iodoform which remain in the ligature until the last portion has been absorbed and thus prevents the ligature or the stump of the vessel from becoming a culture medium for micro-organisms which may be present in the circulation. In any location in which it is possible for pressure necrosis to occur with subsequent infection due to local conditions it is wise to use catgut which is so fine that pressure necrosis is not feared because of the fact that the fine catgut lacks tensile strength enough to crush the tissues sufficiently to cause their death.

Many surgeons use very fine silk ligatures in preference to catgut, but we are convinced that their results are better with this ligature material only because of the fact that with this fine silk they are unable to cause pressure necrosis as they would were they to use catgut ligatures of the ordinary size.

In ligating very large vessels it is well to leave a sufficient portion of the vessel projecting beyond the point at which the ligature has been applied so as to prevent slipping. It is also well to crush the wall of the blood vessel at the point at which the ligature is to be applied by the use of strong hemostatic forceps, as this will crush all of the soft tissues out of the blood-vessel wall and will leave in place only the connective tissue portion. The same principle applies to the ligation of pedicles of considerable size, such as the pedicle of an ovarian cyst, or the cecal end of the vermiform appendix.

SEARING OF BLEEDING SURFACES.

Occasionally there is a constant oozing of blood from the surface of a wound which does not subside under pressure with hot moist gauze sponges. In these cases it is sometimes well to hold a red or white hot cautery iron near the surface without actually touching it. This method is especially useful in case of oozing from bone surfaces. Here the same result may be accomplished by an apparatus commonly used by artists in making burnt woodwork.

It is not often necessary to resort to this method. The application of

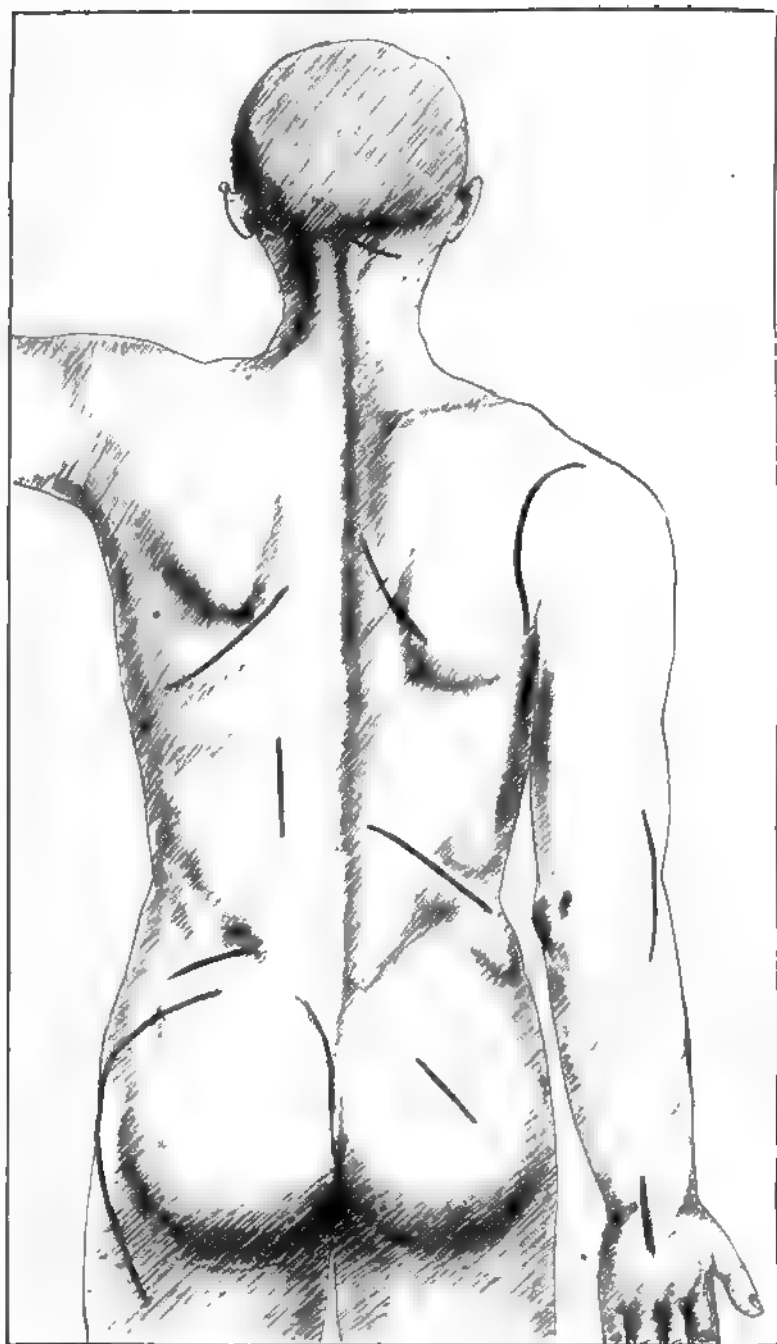


Fig. 5.
Posterior Incisional Lines.

a gauze pad wrung out of very hot, or even boiling water will usually accomplish the same end in a more convenient manner. In using hot moist pads it is important to leave them in place without change for several minutes at a time. If applied to the oozing surface with pressure the effect is more satisfactory.

APPLICATION OF SUTURES.

It is often necessary to apply catgut sutures to bleeding surfaces en masse because the bleeding may be so diffuse that it is quite impossible to catch each one of the innumerable small vessels separately. In these cases a suture is applied around areas and tied in the form of a purse-string suture or two opposing surfaces are sutured together, the pressure thus caused upon both surfaces preventing the diffuse hemorrhage. If the wound is near some of the larger blood-vessels it is, of course, important not to injure these strictures in passing the sutures through the deep tissues.

EXTERNAL PRESSURE.

In many cases in which large wound surfaces are produced, as, for instance, in excision of the breast, it is important to apply large pads of cotton over the surface when the wound is dressed and to hold these in place by the application of soft gauze rolled bandages. The uniform pressure will result in stopping of oozing from the surfaces of these large flaps which may be but very slight from any one point, but which would result in the loss of a large amount of blood from the entire surface were this not prevented by the careful application of pressure by a properly adjusted dressing.

POSITION OF EXTREMITIES.

If there is any difficulty in controlling hemorrhage in the extremities this can always be accomplished by elevating the extremity to its fullest extent and applying pressure at the point of bleeding until the blood-vessel can be ligated in the wound or above it. This is true, especially in the troublesome hemorrhage due to injury to the plantar or the palmar arch. We have encountered such cases in which recurrent hemorrhages have greatly distressed both physician and patient in whom permanent relief was at once obtained upon elevating the extremity, applying a small compress and keeping the part elevated for a week or ten days. It is, of course, important not to permit these patients to lower the extremity too soon because the pressure ensuing is often sufficient to force out the occluding blood clot unless it has had time to become fairly well fixed.

INJURIES TO THE WALLS OF BLOOD VESSELS DURING OPERATIONS.

Occasionally a portion of a blood-vessel wall is intentionally removed during an operation, but much more commonly this happens as an accident, especially to the large veins in operations upon the neck, the axilla or the groin. In these instances it is well to carefully compress the vessel above and below the injured point. If the opening is very small it is often possible to grasp it with one or two hemostatic forceps with rounded ends and

to apply a fine, strong ligature. Usually this will close the opening and the result will be precisely the same as after ligating a lateral branch of a large vein. Under such circumstances it is important to apply the dressings very snugly in order to support the ligature in case of increased intra venous pressure due to vomiting after the operation.

Repair of Bloodvessels.

Should the opening be too large to be closed by this method it may be sutured by means of a very fine needle threaded with very smooth catgut. It is best to use the latter double because the double strand will more perfectly fill the needle punctures. It is well to wait a few minutes after the sutures have been applied before removing the pressure at either side of the wound in order to permit the needle punctures to become adherent to the sutures. The distal compression should be released first and a little later that on the proximal side. The sutures are applied according to a method later to be illustrated in connection with intestinal sutures. It seems best to insert the sutures so that they will not penetrate quite into the lumen of the blood vessels for fear of producing thrombosis.

At the suggestion of McAlester, Guthrie has introduced human hair as a substitute for catgut and silk in suturing blood vessel walls, and his plan seems to be worth imitating. He uses a number 12, 14 or 16 cambric needle which can be obtained at drygoods stores, choosing the small-eyed variety. He threads this with a long human hair and sutures as described above. The hair is sterilized by boiling in paraffin oil. This suture is very fine and still quite strong enough for use.

If the vessel has been cut off entirely it may be united by these sutures, or the two ends may be threaded upon magnesium rings and these can be forced against each other by means of fine, strong catgut sutures.

In all of these operations it is important to exercise great care not to injure the intima in compressing the vessel above and below the wound. Various forceps have been invented for this purpose and metallic bands have been recommended by Halstead and by Matas. Many surgeons apply temporary ligatures while others always have the bleeding controlled by digital pressure.

So long as the vessel walls, and especially the intima, are not injured it does not matter what method is chosen.

In all operations near large veins it is of the utmost importance to exercise great care to prevent tearing these structures as the walls of even very large veins are frequently delicate and consequently very easily torn. It is best first to expose these veins and then to work away from them.

VESSELS SEVERED NEAR THEIR ORIGIN.

Especial care must be followed in ligating vessels which have been severed near their origin. A careless assistant can easily pull the remaining portion of a vein out of the side of the large vein into which it empties, thus leaving a lateral defect in the latter which can often be repaired only with difficulty by one of the methods just described. To make things worse he may make frantic efforts to stop the resulting hemorrhage by wildly applying forceps to the side of the vein usually either increasing the original defect or making new ones. In these accidents it is well always to remember that such an opening can be closed at once without the use of any force •

by simply placing the end of a finger over the opening. Then the vessel can be digitally compressed above and below the opening and forceps can be applied at leisure or the vent can be closed with sutures.

After applying forceps to vessels near their origin it is well always to ligate at once in order to prevent harm from traction upon the handles of the forceps.

SUTURING OF DEEP WOUNDS.

It is important in all deep wounds to have the surfaces absolutely in apposition in order to prevent the formation of spaces in which quantities of blood and serum may accumulate.

In most instances these accumulations will absorb or become organized, but there is always a possibility of infection through the circulation or a slight infection at the time of operation, which would not be sufficient to cause a local disturbance if no good culture medium were provided, and which may cause some delay in the ultimate wound healing in case spaces are left between the wound surfaces.

For this reason it is well to unite the deep layers by means of fine catgut sutures because union takes place within a few hours and then the support will no longer be needed.

Caution Against Tight Sutures.

It is important to bear in mind, however, that nothing is more favorable for the location of infection than necrosed areas due to the application of sutures drawn too tightly. It is consequently best to draw these deep buried catgut sutures only just sufficiently firm to bring the surfaces together, but not firmly enough to cause pressure necrosis.

By using for this purpose fine catgut prepared by any one of the methods already described and preserved in the iodoform-ether-alcohol mixture the results are most satisfactory.

All unabsorbable suture material, like silk, silkworm gut, linen, silver, aluminum or bronze wire is to be condemned for this purpose. It has no advantage over the catgut and has the very serious disadvantage of causing long continued irritation, necessitating ultimately a removal of the suture in many cases.

The material least harmful among these is very fine silk because this will in time become absorbed.

SUTURING OF SUPERFICIAL WOUNDS.

In suturing superficial wounds two kinds of sutures must be considered, viz., those that are used for the purpose of coaptating the wound edges, and those that are used for the purpose of overcoming tension or for protecting the wound against sudden strain, as in case of sneezing, coughing or vomiting. Many wounds are located so that there is no tension at all and in these only the coaptation sutures are needed.

TENSION SUTURES.

Where there is severe tension it is important to study the degree thereof and the direction, and to adjust the sutures to the best advantage of the existing conditions. For this purpose strong silk or wire sutures are most

suitable. The ends which rest against the skin may be attached to lead plates or pledgets of gauze. Since the introduction of the Thiersch method of skin grafting, however, the tension suture is employed to a much slighter extent than formerly, because in most cases it is better to leave a surface to be covered by skin-grafts than to put too much tension on the flaps.

In all cases in which there is tension it is well to leave the edges a few millimeters apart at the time the wound is closed, as this will enable the lymph to escape from the edges of the wound thus preventing the edema which is certain to occur if the wound edges are closely sutured, and this edema favors necrosis of the flap. This is especially to be borne in mind in all cases in which there is arteriosclerosis, and still more in cases that are suffering from diabetes.

Wherever it is possible to plan an operation so that there will be no tension this should be done, and in no case should sutures be tied tightly enough to cause pressure necrosis.

SUPERFICIAL SUTURES.

In suturing superficial wounds certain principles must be observed without regard to suture material.

1. Sutures should be drawn just tightly enough to bring the wound edges together, but not sufficiently tight to cause pressure necrosis.

2. Allowance should be made for the edema which always occurs a day or two after the operation.

3. The bite of the needle should be equal on both sides of the incision, both as to depth and length of stitch.

4. The tension should be disposed of by one set of sutures, the coaptation by another which may, however, also be accomplished by making one deep and one superficial stitch alternately.

METAL CLIPS.

Many different metal clips have been invented and some of these are quite as satisfactory as the various sutures which have been described; they are, however, much more expensive and this element must be considered especially in hospital work. Results are no better than with sutures, consequently their employment must remain entirely a matter of personal choice.

NON-ABSORBABLE SUTURE MATERIAL.

The most useful suture materials of this class consist of silk, linen, horsehair, silkworm gut, silver, bronze, or aluminium wire. The first, second and third may be impregnated with celluloidin or with paraffin to prevent the entrance of pus. The others are all impermeable. All of these materials may be used both as superficial, removable sutures or they may be buried, but in the latter case they are certain to cause much annoyance both to the surgeon and to the patient, because in the event of infection they will later have to be removed and usually the patient will have this service performed not by the surgeon who applied the sutures originally, but by some one who never uses unabsorbable buried sutures, or by another who has for some time abandoned this practice.

If applied as buried sutures it is important not to include muscles in

the bite of the suture, as the contraction of the muscles is very likely to cause these unabsorbable sutures to act as irritating foreign bodies.

Each of these materials has its advocates because of some especial virtue, such as pliability, ease of application, non-absorption of wound secretion, slight antiseptic qualities as with silver wire, slight elasticity, as in case of horsehair, cheapness, as in case of silk, linen and horsehair.

As a matter of fact if applied without tension all of these materials are very satisfactory. The various conditions under which one or the other is preferable will be mentioned in connection with the particular operations.

ABSORBABLE SUTURE MATERIAL.

Catgut is the only absorbable suture material that needs to be considered because if properly prepared it fills every requirement. It is more expensive than silk, linen and horsehair, and should consequently not be used where these will serve the same purpose. It is quite as satisfactory in every particular as kangaroo tendon, and vastly superior in many respects and should therefore displace the latter entirely.

If the methods of preparation and preservation described heretofore are carefully carried out this material is absolutely reliable both as regards tensile strength, time required for absorption and absolute asepsis. These methods are moreover so simple that any honest person can have perfect results and there are many manufacturers who supply the catgut prepared so that it can be used without any fear of infection from this source.

AFTER TREATMENT OF ASEPTIC WOUNDS.

Don't Meddle.

It is most important to bear in mind that the less one meddles with aseptic wounds after they have been carefully sutured and dressed the more certain one can be of obtaining primary union. If the sutures have not been drawn too tightly there will be no pressure necrosis and consequently the staphylococci which are always present in the skin will not find any culture medium. It is well to dress the wound on the fifth to the seventh day, being careful not to pull the united wound edges apart by rough handling. Then it is well to paint the line of suture with compound tincture of iodine and remove the superficial sutures, then once more paint the surface with the same solution, and then reapply an aseptic dressing leaving the deep sutures to be removed later as indicated in connection with the various operations.

Support by Strapping.

The tincture of iodine seems to obliterate the little suture marks.

When the deep sutures have been removed it is well to apply a rubber adhesive plaster to each side of the wound and about two inches away from its edge. These straps should contain a number of tapes, about one for every four cm. of length of wound. These straps are applied and left untied for a day or two in order to secure perfect attachment to the skin then the tapes, which should be so arranged as to be opposite each other, should be tied sufficiently firm to remove all tension from the wound itself. In this way it is possible to obliterate the scar almost completely. Unless this precaution is taken the wound frequently becomes drawn out into an ugly, broad, white, disfiguring mark.

Unless the sutures are tied loosely each one leaves a transverse mark across the wound, which is also likely to be very unsightly.

Occlusive and Antiseptic Applications.

Various substances have been recommended for application to the wound for the purpose of preserving asepsis and preventing the formation of ugly scars, of these flexible collodion and concentrated tincture of benzoin are the best. Of the various powders those that are non-irritating and odorless and contain some form of iodine are the best. Most of these are made under some patent and as wounds heal quite as perfectly without their use it does not seem proper or necessary to mention them specifically.

Avoid Any Unnecessary Manipulations.

It is very important never to crush or manipulate wounds at the time of dressing. Inexperienced assistants seem to have an insane desire to feel of wounds and there can be no doubt that the gratification of this desire results in the infection of many wounds which would otherwise heal by first intention.

Removal of Sutures.

In removing the superficial sutures great care should be exercised not to separate the delicately united wound edges. It is much better not to touch these sutures for two weeks after they have been applied than to disturb the edges in the least while removing them early in order to prevent the stitch marks. A careful assistant, with reasonable patience can, however, remove these superficial sutures with proper forceps and scissors without fear of causing this disturbance.

AFTER TREATMENT OF PRIMARILY SEPTIC WOUNDS.

Every surgeon encounters many wounds that are primarily septic in cases which come to him because of the presence of a septic condition.

In these the following results must be obtained:

1. The accumulation of septic material must be evacuated.
2. Provision must be made against reaccumulation of septic material.
3. Absorption of septic material must be prevented.

The first of these conditions is accomplished by free incision which must of course be varied according to the character and the location of the infection. The second object is accomplished by the use of drainage tubes or tampons which must again vary according to conditions, and this will in turn accomplish the third object. These steps will cause the lymph stream to pass away from the infected tissues carrying with it the septic material which is deposited upon the dressings. Thus the infection of tissues hitherto free will be prevented in a physiological way. In the meantime if the infection is in an extremely venous congestion should be prevented by elevating the extremity and progress of the infection through the lymph channels should be prevented by placing the part of the body affected perfectly at rest.

The elimination through the lymph stream can be stimulated by the application of warm moist dressings. It is possible that by adding mild, non-poisonous antiseptics like boric acid and alcohol to these dressings that they will further aid the processes of disinfection. Kahlenberg has demonstrated that boric acid is rapidly absorbed when applied in aqueous solution

externally, whether in sufficient quantity to have a beneficial effect has not been proven although clinical observation seems to bear out this idea.

Later on the healing can be accelerated by stimulating the wound surfaces by the application of compound tincture of iodine or 2 to 10 per cent. solution of nitrate of silver, or any one of a number of other substances. In case of septic cavities the application later on of Beck's bismuth paste,—one part of arsenic, free bismuth subnitrate in two parts of vaseline,—is followed by excellent results.

This should be applied at first each day and later on less frequently, and should be kept in contact with the deep surfaces by transfixing the external wound.

AFTER TREATMENT OF CLEAN WOUNDS BECOMING INFECTED.

Whenever there is any evidence of infection occurring in a wound which was primarily clean it is well at once to remove several sutures, especially at points showing redness, and to apply a large, hot, moist antiseptic dressing consisting preferably of one part of alcohol and two parts of a saturated aqueous solution of boric acid to the surface, and to cover this dressing with some impermeable substance like gutta percha tissue or oiled muslin. These wounds should not be manipulated. If the infection does not subside at once then the wound should be opened a little further or in severe cases it may become necessary to open the wound throughout.

From this point on the treatment should be the same as in the cases just described. Usually the infection, however, subsides promptly upon taking the first step mentioned above. In each case the cause should be determined. It is usually a slight error in technic which can readily be corrected to the benefit of patients operated on subsequently.

Prevention.

Of course benefit must come chiefly from prevention, and this must depend largely upon the organization of a reasonable system, and in this system every person must fully appreciate the fact that he carries an important portion of the responsibility. In this the permanency of service is a most important matter so far as the assistants are concerned, and permanency of methods is equally important, chiefly because of the fact that this secures conditions in which possible flaws or weak points are known and can be guarded against, and because any neglect in carrying out the methods can be more readily recognized than when changeable plans are employed.

SURGICAL INSTRUMENTS.

It is well to become accustomed to the use of as few instruments, and of as simple construction as possible, as in this manner the surgeon becomes so familiar with each instrument that he can use it with the same facility that the skilled artisan shows in the use of his tools. This enables the surgeon to reduce the time required by the operation to a minimum, and at the same time each operation when completed is technically as nearly perfect as it can be.

PART II.

SURGERY OF THE HEAD.

INJURIES TO THE SCALP.

Infection Favored by Location.

In considering scalp injuries it is important to bear in mind the fact that the conditions in this location are especially favorable for the occurrence of infection, and that it is especially in persons who are most liable to scalp injuries that the conditions are most favorable for infection, primarily because working people, and notably those working among horses and cattle and on the streets, are certain to have unclean scalps, and, secondly, the dirt with which they come in contact is most likely to contain pathogenic micro-organisms, of which the pyogenous staphylococci and streptococci are most numerous. In persons working among horses the tetanus bacillus is also frequently present. It is consequently proper at this point to refer to the matter of disinfection of the scalp as this is of the very greatest importance, even though there may be no fracture of the skull. The scalp is likely to contain the streptococci of erysipelas, and this infection may extend through the skull by way of the veins—giving rise to a septic meningitis. In my experience this has happened in a number of cases in which the injury was due to a blow with a blunt object, such as a brick or a piece of iron or anything hard or heavy. The disinfection in these cases should be just as thorough as though an operation were contemplated; and it is well afterward to apply a moist, antiseptic dressing of some kind and cover with some impermeable material, such as gutta percha, in order to complete the disinfection. The sooner this is accomplished after the time of the injury the better. It is unfortunate if it be postponed until the tissues have become edematous as a result of infection.

In these cases the amount of hemorrhage has usually been so considerable that the hair is thoroughly saturated with blood.

Antiseptic Measures.

If the wound is fairly clean-cut and not very large it usually suffices to wash the scalp thoroughly with soap and hot water, then to shave away the hair for one or two cm. beyond the edge of the wound in all directions and then to wash the surface with strong alcohol and with one to one-thousand corrosive sublimate in hot water; then again with strong alcohol and finally to mop the wound and the surrounding scalp with strong compound tincture of iodine.

If the wound is very small and if one is certain that there is no fracture of the skull it is often not necessary to shave away any of the hair if the scalp is thoroughly treated according to the method just described.

On the other hand, if the scalp has been badly crushed and if the wound is extensive, and especially if there is a fracture of the skull, it is often best to shave the entire head so that in the manipulations which will be required in treating the conditions found, there is no danger of carrying infectious material from the remaining hair to the wound or to the meninges.

Application of Tincture of Iodine.

Recently disinfection without preliminary scrubbing by saturating the dry surface with strong tincture of iodine, or 10 per cent of iodine dissolved in benzine or in chloroform, has been advocated. In cases in which the wound has been disinfected immediately and simply dressed with dry aseptic dressing and sent to the hospital for treatment, arriving dry, this method may be acceptable. In the usual scalp wounds, however, it seems unwise to depend upon this simple course.

When the Wound is Clean-cut.

When the wound is clean-cut and there is no undermining of the scalp it is well to apply just a sufficient number of sutures to secure coaptation, but no more, in order to permit the serum to escape between the sutures. This will insure rapid healing, even if there is a slight amount of infection, because the blood supply is very abundant and the serum escaping between the sutures will eliminate safely a considerable amount of septic material.

When the Tissues Are Undermined.

If the edges of the wound are undermined the wound should be enlarged to a point just beyond the undermined portion and then sutured, with a little space left open for drainage at each end. If the undermining is extensive it is well to make one or more small incisions at the base of each flap caused by the undermining, and in bad cases to draw small drainage tubes or strands of silkworm gut, or folded gutta percha tissue, through these openings to facilitate drainage.

It is desirable to cover the wound with a hot moist dressing composed of aseptic gauze wrung out of a mixture of two parts of a 4 per cent solution of boric acid in hot water and one part of strong alcohol. Some impermeable substance, like gutta percha tissue or oiled silk, is placed over this and cotton and a bandage over all.

INFECTED SCALP WOUNDS.

It frequently happens that scalp wounds are sutured hurriedly, without sufficient cleansing, directly or some time after their occurrence, or that they are not cared for at all for some hours or even days after their infliction, and that when they finally come under the attention of a surgeon infection has taken place, which may be of any degree of severity from the slightest infection to a degree so severe that the patient's temperature may exceed 105° F., or he may even be unconscious.

Thorough Opening of Infected Wounds.

In these severe cases it is wise invariably to remove all of the sutures and to open up the wound widely. Upon doing this we have found all kinds of objects, like hair, straw, sticks of wood, stones, sand and many other

things sewed up in such scalp wounds. In these cases the wound should be enlarged to the extent of the undermining and a number of small incisions should be made at the base of each flap. The space underneath the flaps should then be loosely packed with moist gauze and the entire scalp covered with the hot moist antiseptic dressing previously described. This should be renewed daily until the sepsis has entirely subsided and then the edges of the wound should be sutured loosely and dressed as a clean scalp wound.

Immunising Tetanus Antitoxin.

If the wound has been soiled with street dust or with garden earth, or if the patient has recently come in contact with horses, from 1,000 to 3,000 units of tetanus antitoxine should be injected subcutaneously. If this soiling, just named, has been severe it is well to repeat the injection after twelve or twenty-four hours. If the scalp wound is in the vicinity of the external auditory meatus it is advisable to place a few drops of strong compound tincture of iodine in the meatus, so that all parts of its surface will be covered with this remedy, and after half an hour the ear should be filled with a 10 per cent solution of carbolic acid in glycerine. This application of carbolic acid and glycerine should be repeated once or twice daily until it is certain that the wound will not have an erysipelatous complication. In case this should, however, occur the treatment should be continued in order to prevent an infection of the meninges through this channel.

TUMORS OF THE SCALP.

Sebaceous Cysts.

The most common tumors in this region are sebaceous cysts, which may vary in size from that of a bird-shot to that of a fist, although they usually become infected before attaining extreme size and they then necrose at some point and their contents is spontaneously evacuated through the opening thus formed. They may also be injured by the use of comb or hatpin and a superficial ulcer thus may occur which usually induces the patient to give the condition surgical attention.

There is no pain in these cysts unless they are inflamed, but they are the cause of marked deformity and much inconvenience in dressing the hair.

Modern Treatment and Recurrence.

In preantiseptic days there was much prejudice against surgical treatment of this condition because of frequent recurrence, and the operation was often followed by an erysipelas which sometimes resulted in the death of the patient. The first objection has now been eliminated owing to the certainty with which it is possible to remove the entire cyst wall. It is, however, to be borne in mind that every sebaceous gland in the scalp is capable of forming a sebaceous cyst, and consequently the removal of the existing cysts will not prevent the formation of further similar cysts from any of the remaining sebaceous glands in the scalp.

It would consequently not be wise to give the patient the impression that by having the existing cysts removed he would in the future be free from this condition. Indeed, it has been found that persons who have once had sebaceous cysts of the scalp are especially liable to the formation of similar growths from other sebaceous cysts in the same region. It is also

well to examine carefully all of the portions of the scalp before the operation, in order to discover any small cysts which may be just appearing.

Early in the antiseptic era it was customary to shave the entire scalp before removing even a single sebaceous cyst, in order to secure an absolutely perfect asepsis.

This is no longer necessary, as it has been found that if the plan of disinfecting the scalp that has just been described is carried out the wound resulting from the operation will regularly heal by first intention, even if no part of the hair has been shaved.

It is claimed that by simply saturating the dry scalp thoroughly and repeatedly with compound tincture of iodine for a period of ten minutes and permitting this to become dry that the operation can be performed safely without any further attempts at disinfection. In place of the compound tincture of iodine a 10 per cent solution of iodine in benzine or in chloroform may be employed.

Our own results have been so absolutely satisfactory by following the method described above that we have not undertaken to test these iodine methods, which are, however, vouched for by perfectly reliable authorities with much experience and good surgical judgment.

Technique of Removal.

The cysts having been definitely located, counted and marked by the application of a spot of tincture of iodine directly over the mass, the hair is separated and a sharp-pointed scalpel is thrust directly through the scalp and the underlying cyst, splitting the latter and its contents in halves. The cyst wall is much more adherent to the surrounding tissues at its most superficial point than elsewhere on its surface, hence it is wise to grasp the deepest portion of the cyst wall with hemostatic or dissecting forceps and to enucleate it from within outwards. In a fraction of a minute a cyst can be removed in this manner and unless too large a number of cysts are present the work can be done without general or local anesthetics. If there are several of these cysts present it is well to administer morphin hypodermically half an hour before the operation in order to blunt the sensibility of the patient to some extent.

The wound must be carefully examined to determine that no part of the cyst wall has been left behind. If these steps are carefully carried out it is but seldom that any portion of the cyst wall remains.

This method is much more satisfactory than the removal of these cysts by dissection, not only because of its ease and rapidity, but also because of the fact that recurrence follows much more rarely, if at all, on account of leaving portions of the cyst wall. From one to three fine cutgut sutures should be introduced and a gauze and cotton dressing applied, which may be removed in one week. Other benign tumors, like lipo-fibroma, angioma, lymphoma, occur underneath the scalp and these are treated as elsewhere in the body.

Sarcoma and Carcinoma.

Sarcoma and carcinoma of the scalp should be treated by wide excision, together with periosteum covering the skull. It is well to apply the actual cautery to the surface of the bone after the tumor has been removed and to secure deep cauterization of the bone in this way. The cauterized bone will be exfoliated after several weeks and the surface may be covered with Thiersch skin-grafts unless the tumor is located at a point at which this

would leave an especially unsightly deformity, in which case the scalp covered with hair from some other part of the head may be mobilized in the form of a flap of proper size and this may be slid over the defect and sutured in place. The new defect which has been formed in this manner should be covered with Thiersch grafts at once.

TUBERCULOSIS OF THE SCALP.

Tuberculosis of the scalp is not a common condition. When it does occur it should be treated by the method just described for the relief of malignant growths unless the area involved is small, in which event it is well to destroy the infected tissue with the actual cautery down to the skull, including the surrounding tissue for a distance of one c.m. When the eschar has separated, the surface should be covered by a Thiersch skin-graft.

NON-TRAUMATIC INFECTION OF THE SCALP.

Non-traumatic infections of the scalp should be treated like the same condition involving other parts of the skin, but it is important to remember the fact that apparently non-traumatic infections of this region are usually due to traumatism caused by the presence of parasites or to scratching to relieve itching of a scalp which is not kept clean. We have seen more of this since the introduction of the fantastic fashion of hair-dressing in vogue at the present time.

In the former case it is important as an initial step to destroy the parasites and to place the hair and the scalp in an aseptic condition, and to prevent reinfection from the material used in dressing the hair. In the second place, it must be borne in mind that it is much more difficult to use moist antiseptic dressings effectively on hair-covered skin surfaces unless especial attention is paid to this condition, as the hair is likely to become matted together and to prevent the antiseptic fluid from touching the underlying skin.

It is but rarely necessary to remove the hair, however, if the dressing of these cases is carried out carefully and intelligently, but if left to assistants, without especial instruction, these cases usually progress badly.

In all other respects the treatment must be the same as for infections of other portions of the skin.

INJURIES OF THE SKULL.

Diagnosis.

Although injuries to the skull are more commonly associated with wounds of the scalp, it is important always to remember that the absence of an external wound does not necessarily mean an absence of skull injury, and it is just in these cases that a diagnosis is often difficult and sometimes impossible. If a definite depression of the bone can be felt the diagnosis is easily made, but this is sometimes simulated by an abrupt depression due to the fact that the subcutaneous tissue has been crushed by a heavy, sharp-edged object, which has left a portion of the subcutaneous tissue entirely untouched, while the tissue just beyond has been so thoroughly crushed that it feels like a depression, while the sharp edge of the tissue beyond feels like the edge of the fractured bone.

In case of doubt it is always best to expose the area in question by making a scalp flap sufficiently large to allow one to examine the conditions. This will not often be necessary, because with some experience one is able to recognize this condition, but the method is undoubtedly justifiable in case of doubt.

Fracture of the skull may cause no immediate symptoms aside from the shock and temporary unconsciousness due to the accompanying concussion of the brain. The injury may consist of a single fissure with or without laceration of periosteum or dura, or both, or it may be accompanied by more or less severe depression. The bone may be driven into the substance of the brain, or the latter may be quite uninjured because of its elasticity and the character of the blow.

Of the injuries to the blood vessels a laceration of the meningeal artery at some point is most common and this is by far the most treacherous condition because of the ease with which it may be overlooked unless the possibility of its occurrence is kept very prominently in one's mind, even in connection with head injuries which at first seem so slight as to be scarcely worthy of serious attention.

LIGATION OF THE MIDDLE MENINGEAL ARTERY.

These cases very commonly have the following history: A patient receives a slight injury from which he recovers in a very short time, usually within a few minutes. He is able to go to his home, but later on becomes unconscious, his pulse becomes slow, and unless relief is secured within a very short time the patient succumbs to the effects of intra-cranial pressure. The history in these cases is usually so clear and the symptoms so pronounced that there is little difficulty in making the proper diagnosis unless the surgeon is called too late, because the patient's primary injury has been overlooked on account of the apparent slowness of its character.

The treatment in these cases must be applied at once, for if it is neglected the patient's condition will soon become hopeless.

Details of Operation.

The danger of infection of the meninges is greatly reduced by thoroughly shaving the entire scalp before the commencement of the operation. If only a small portion of the surface is shaved it is likely that during some part of the operation some one will carry infectious material from the remaining portion of the scalp to the wound and thus cause an infection, which in these cases is always serious. If the entire scalp has been carefully shaved the further disinfection is no more difficult than disinfection of the skin in any other portion of the body.

If the point of injury can be distinctly located in the course of one of the principal branches of the middle meningeal artery, the point of operation can be determined in this manner. If this cannot be done it will become necessary to expose first one and then the other of the principal branches of this vessel, provided the first attempt fails, or it may be better to expose both branches at once by making an osteoplastic resection of a portion of the skull, covering both the anterior and the posterior branches of the middle meningeal artery. The following guide will suffice to locate these branches:

The anterior branch crosses a point one and one-fourth inches back-



Fig. 6



Fig. 7



Fig. 8.

DE VILBISS FORCEPS.

Fig. 6 represents the forceps when partly closed. Fig. 7 indicates the proper manner of holding the forceps in the left hand while introducing the punch (c) through the trephine opening and sliding it through the groove in the skull, which has already been made, the right hand being employed entirely for the purpose of closing the handles and thus forcing the punch through the bone within its grasp. Fig. 8 represents the proper form of trephine to be used. Its central shape prevents injury to the dura, because it locks the trephine the moment the bone is cut through, because this at once causes all of the lateral teeth to become imbedded in the hole which has been cut.

ward and upward from the external angular process of the frontal bone. The posterior branch crosses a point at which this line crosses a line drawn vertically from the anterior edge of the mastoid process. An opening can be made at these points by means of a trephine one-half inch in diameter; the instrument should, however, be conical in shape so that as soon as the inner table of the skull has been perforated by it the instrument is stopped automatically from penetrating deeper and causing an injury to the dura. It is usually best to make an oval skin flap covering the area traversed by both the posterior and the anterior branches of the middle meningeal artery, so that if the injury is not found in the anterior branch, which is most commonly the seat of trouble, an elliptical-shaped flap of the parietal bone may be cut loose by means of DeVilbiss forceps. In this way much time can be saved and the surface can be so thoroughly exposed that no error is possible, as shown in Plate I.

In making the resection of the skull the size and form of the flap may be regulated by directing the instrument. A flap sufficiently large to cover the space occupied by the posterior and anterior branches of the middle meningeal artery can be cut with the DeVilbiss forceps in a very short time, usually less than ten minutes being required for this purpose. It is, however, necessary to bear in mind the technique required in the use of these forceps. The cutting portion of the forceps should be introduced through the originally provided opening, and then it should be slid along the cut which has already been made until the end is engaged under the portion of the skull to be severed. Unless this precaution is taken the work will progress very slowly. The small bridge at the base of the bone-flap is weakened by the application of a few strokes of the chisel and then it is fractured by inserting a strong chisel opposite this point and elevating the flap. The bleeding vessel is now exposed and ligated by passing about it a fine catgut ligature threaded in a needle, the clot is sponged away, the bone flap is replaced, and the overlying skin is sutured. If there is still some oozing after the injured portion of the meningeal artery has been ligated it is wise to place a small capillary drain underneath the flap to prevent re-accumulation of blood.

CHRONIC SUB-DURAL HEMORRHAGE.

Occasionally the hemorrhage from some very small ruptured branch of the meningeal artery is so slow that no immediate symptoms are discovered for days or weeks or, as in one of our own cases, for three months.

The first symptoms may consist of only slight headaches, with a feeling of pressure in the region where the blood is accumulating. Later the pain becomes more severe, but frequently the injury to the head has been forgotten by the patient and his friends, so that the surgeon does not receive any information regarding this most important element of the history. Then pressure symptoms occur in the form of paralysis, and if the pressure is over the area of the speech center there may be at first some slight difficulty in articulation, which becomes more and more marked until complete aphasia occurs. Later the irritation caused by the pressure may result in mania. Aside from these symptoms the typical evidences of increased intra-cranial pressure may be noticed. This usually gives rise to a diagnosis of intra-cranial tumor unless the condition is attributed to the original injury.

Technique.

The method of operating is the same as for ligation of the middle meningeal artery as regards the formation of skin and bone flaps. When the dura has been exposed it will be found to bulge and no pulsation can be detected.

An incision of the dura will evacuate either clotted blood or serum or both. In cases in which the injury has occurred a considerable time before the operation the cavity is likely to contain only serum, which is usually colored with blood pigment.

This accumulation may vary in size from a capacity of a few cc. to 500 cc. or more.

It is surprising how quickly the symptoms disappear, even in cases that have suffered from cerebral compression for a considerable period, provided the increase in pressure was very gradual.

The wound in the dura should be closed with fine catgut sutures. Some silkworm gut strands or some folded gutta percha tissue should be used for drainage from one angle of the wound and a large external dressing should be applied. In one of our cases there was a slight re-accumulation probably from secretion from the walls of the space in which the original accumulation had taken place.

Simply reopening one angle of the wound very slightly permitted this fluid to escape and then the recovery progressed uninterruptedly and the patient remained permanently well.

Important To Recognize the Indications.

It is really very important to bear this condition in mind in dealing with patients suffering from headaches and other pressure symptoms, because most of the reported cases suffered for a long time before a diagnosis was made. The condition is undoubtedly never recognized in many cases. If the fluid accumulates more rapidly these patients die from cerebral compression.

LACERATION OF BRAIN TISSUE.

In connection with the compound comminuted fractures of the skull more or less laceration of brain tissue is common. After removing the loose fragments of bone and discarding those that have been soiled and preserving the others in warm normal salt solution, the ragged portions of brain tissue which project through the dura should be cut away with very sharp scissors and the tears in the dura should be approximated with fine catgut sutures. Then the clean fragments of bone are placed over this surface and the periosteum sutured over these. The wound is drained with strands of silkworm gut or gutta percha tissue and a large dressing is applied. In all of these cases if conditions are not favorable for immediately doing the required operative work, it is well to saturate the scalp with compound tincture of iodine and to apply an aseptic dressing after controlling the hemorrhage and then to send the patient to a hospital, where the required operative care can be given at the earliest possible moment.

DEPRESSED FRACTURES OF THE SKULL.**Do Not Delay Elevating.**

In the treatment of acute injuries of the skull, it is important to remem-

ber that depressed fractures, although frequently not accompanied with serious symptoms at the time of the injury, are likely to result in exceedingly serious late conditions, unless the difficulty is relieved quickly after the injury. The irritation resulting from a depressed fracture frequently gives rise to epilepsy at some time after the occurrence of the injury. In order to prevent this, it is important in every case in which there is a depressed fracture to elevate this at once, which can be accomplished by exposing the seat of the fracture by an incision through the scalp, the latter having been shaved as indicated in connection with previous operations on the part. If the fracture is comminuted a small portion of bone can usually be removed by the introduction of the sharp edge of a chisel, and with the use of this instrument, together with the sequester forceps, it is usually possible to adjust the portions of the depressed fracture very accurately. If this cannot be done it is safer to sacrifice some portions of the skull than to leave any depressed part to irritate the meninges.

If an injury is found in the dura this should be sutured with fine catgut. After the skull has been carefully adjusted the scalp is sutured over this with or without capillary drainage, according to the amount of oozing that remains. Care should be taken to sacrifice as little as possible of the skull, and in simple fractures fragments may be replaced with safety, although they may be entirely separated both from the dura and the periosteum. In compound fractures the same plan of treatment must be pursued, with the addition of very careful disinfection, the removal of all fragments of the skull which may have become infected in the least and the use of drainage in all of these cases.

Choice of Bone Chisel.

In all chiseling operations upon the skull and elevations of fragments, the ordinary carpenter's chisel and a mallet, such as the one used by wood carvers, are of the greatest convenience. Most bone chisels which can be obtained in instrument stores are practically useless for this purpose, because they are either clumsy or difficult to handle, while the carpenter's chisel can be used with ease by any one who has the least manual capacity. A convenient amount of bone may be cut away in a few moments with this instrument and the form of the incision in the bone can be easily controlled. The chisels are so sharp that their use does not give rise to any severe concussion. This is especially true if the edge of the chisel is held nearly parallel with the surface of the bone. A number of chisels should be at hand, so that if any defect occurs in one it may be laid aside and another substituted at once.

TREPHINING FOR THE CURE OF EPILEPSY.

In cases in which epilepsy follows fracture of the skull and in which it is possible to determine positively from focal symptoms that there is a definite point in the cerebrum which is being irritated by some condition resulting from the fracture, it may be proper to remove a portion of the skull overlying the area which has been determined and to remove any irritating substance it may be possible to discover. Occasionally an exostosis has developed from the line of fracture in the form of a sharp spicule of bone, or a fragment may have been displaced at the time of the original injury and may extend into the substance of the brain, or a small

cyst may have formed on the under surface of the dura or the latter may be markedly thickened, or there may be a considerable amount of cicatricial tissue in the brain substance, resulting from the healing of a tear.

All of these may readily be relieved by excision, but unfortunately this does not result in a cure in many of the cases of epilepsy which are unquestionably traumatic in origin.

Importance of After-treatment.

In the after treatment of these cases that have been treated surgically it is important to insist upon good hygienic and dietetic care for a long period of time following the operation. It is also well to give these patients as nearly as possible a salt-free diet and to have them use a very small amount of bromide of soda, in place of table salt, on their food. All excitement, overwork, exposure to heat, and every other form of physical and mental irritation should be avoided. The use of thyroid extract may be tried by giving from three to four doses daily of three to five grains.

We have used this form of treatment in many cases, and although its results have been disappointing time and again, still there have been a sufficient number of cases in which the results were satisfactory to make the effort worth while.

This is true especially of the cases in which we have been able to direct the diet and hygiene of the patient subsequent to the operation.

Many of these patients have acquired careless or erratic habits of life and especially unfavorable habits of diet, both as regards time of eating and quantity and character of food. We have observed patients who remained perfectly well for months or years who had a recurrence of an epileptic seizure after eating an unreasonable amount, or after eating a large meal when exhausted after a day's labor.

One of these cases remained well until he worked beyond his strength for a number of days in the hay field, after having been well for two years following an operation for the relief of a depressed fracture of the skull. This case had suffered from epilepsy for several years previous to the operation.

It seems clear that although the local irritation in the cortex may have been relieved by the operation any one of a number of correlating influences affecting the patient's general condition may be the cause of a recurrence, hence the wisdom of careful control of the patient after operation.

TUMORS OF THE SKULL.

Tumors of the skull, which result from invasion of tumors of the scalp, are the only ones that we have operated with permanent recovery of the patient. In these instances the most satisfactory results have been obtained by removing the tumor of the scalp, together with a large area of surrounding, apparently healthy tissue, and then applying to the surface of the entire area of exposed skull, and also to the edges of the scalp wound, large cautery irons heated to red heat, being careful, however, not to leave the iron in contact at any one point long enough to cook the underlying meninges or brain. The Paquelin cautery does not hold a sufficient amount of heat to be of much use for this purpose as the large cautery irons, preferably ordinary soldering irons, heated in a large gas or alcohol flame.

A dry dressing is then applied to the wound, which is later dressed

antiseptically until the granulation tissue causes the sequestrum to loosen, so that it may be removed easily. Then the entire surface is covered with Thiersch grafts.

PRIMARY TUMORS OF THE SKULL

When these are quite circumscribed they should be removed with the overlying skin and the underlying dura; at least two cm. of skin should be removed in every direction beyond the edge of the tumor.

Personally, we have never encountered any primary tumors of the skull in which it was possible to make a complete removal of the growth by this or by any other method, but this does not make such a condition impossible, and it is quite conceivable to obtain permanent results in cases coming under treatment reasonably early.

TUBERCULOSIS OF THE SKULL

This condition is not very uncommon and the results of surgical treatment are relatively favorable if two requirements are observed, viz., 1st, careful removal of every portion of the infected tissue, and, and, careful control of the diet and hygiene of the patient after the operation.

In these cases one should never attempt the removal of the diseased tissue by means of the curette through the sinuses in the scalp, a method which had been practised unsuccessfully in every case that has come under our care to the present time. If a radical operation is not feasible for the time being, the patient should be placed under careful dietetic and hygienic treatment temporarily and the sinuses should be injected full of Beck's bismuth paste, consisting of one part of bismuth subnitrate and two parts of yellow vaselin. This should be repeated from one to three times per week, according to the progress of the case.

The discharge from the sinuses will become aseptic after a short time and complete healing may ensue, although my personal experience with the paste in this part of the body has not been sufficient to determine this with certainty.

Technique.

It is highly important to make a large incision in order that every portion of the diseased bone may be exposed after the periosteum has been reflected, together with the skin flap. Beginning at the opening of any one of the sinuses of the skull, the outer table is chiseled away with a very sharp carpenter's chisel. In order to find all portions of the diseased bone it is important to observe the granulation tissue projecting from the cut surface of the bone after carefully sponging away the blood. Sharp gnawing bone forceps are very useful in this operation, but there is no instrument of as much value as the sharp carpenter's chisel and gouge.

After all of the sinuses have been followed and every portion of the infected tissue has been cut or curetted away so that there is at no point any granulation tissue to be found, the surface is dried and then saturated for ten minutes with 95 per cent carbolic acid; then it is covered with strong alcohol until the white color caused by the carbolic acid has entirely disappeared, after which it is thoroughly covered with strong compound tincture of iodine. A little silkworm gut or rubber tissue drain is placed and the wound is sutured.

In the rare cases in which the overlying scalp has been destroyed by the disease a sufficient amount of the surrounding tissue is removed by the actual cautery to insure a complete removal of all of the diseased tissue and then the entire surface is covered with Thiersch skin grafts, after the bone surface has become covered with granulation tissue.

CLOSURE OF BONY DEFECTS IN THE SKULL.

In case a considerable portion of the skull has been entirely removed, it may become desirable to close this defect in order to protect the patient against an accidental injury of the exposed portion of the brain. This becomes necessary only in cases in which the defect is very large, or in which it gives rise to some form of annoyance to the patient. The latter may feel a sense of insecurity or he may be annoyed by extreme heat or cold, or there may be a sensation of pain, or the constant pulsation of the area may give rise to a feeling of nervousness, or the irritation may occasion attacks of epilepsy. In either case the defect may be closed by the insertion of a foreign substance between the scalp and the dura, such as a thin plate of celluloid, which may be boiled and cut the exact shape of the defect, with a sufficient margin to hold the plate when inserted underneath the rim of the defect in the skull. If such a plate is implanted aseptically it will remain for an indefinite period of time without giving rise to any annoyance. We have used such plates in a number of cases with perfect satisfaction. It must be remembered, however, that in cases of epilepsy the number of cures from the use of such a plate is relatively very small.

An autoplasmic bony closure may be accomplished by cutting an oval flap of the scalp directly along the side of the defect with a pedicle sufficient to supply circulation to the flap; then cutting a second flap of the same shape directly covering the defect and having its pedicle in the opposite direction from the one first made. The second flap is dissected loose, leaving the dura in place. The latter is then loosened from its attachment to the rim of the opening and with a thin, broad chisel a thin layer of the skull underlying the first flap is chiseled loose and left in contact with the flap. The latter is then transplanted over the defect in the skull and sutured in place, and the second flap is then sutured into the space from which the first flap has been removed. In this manner all portions of the scalp will remain covered with hair and the bone carried with the first flap will effectually close the defect in the skull.

Usually this operation has been performed by removing the scalp from the surface of the defect and transplanting a flap from a neighboring portion of the skull and then covering the defect with skin grafts, but the method which has just been described is very much more satisfactory, as it does not leave a portion of the scalp without its hairy covering.

CEREBRAL LOCALIZATION.

In order to intelligently approach surgical conditions within the cavity of the skull, affecting portions of the brain, it is absolutely necessary to have a clear conception of cerebral localization.

We have personally always depended upon some one of our colleagues whose opinion, from a neurological standpoint, was so vastly superior to

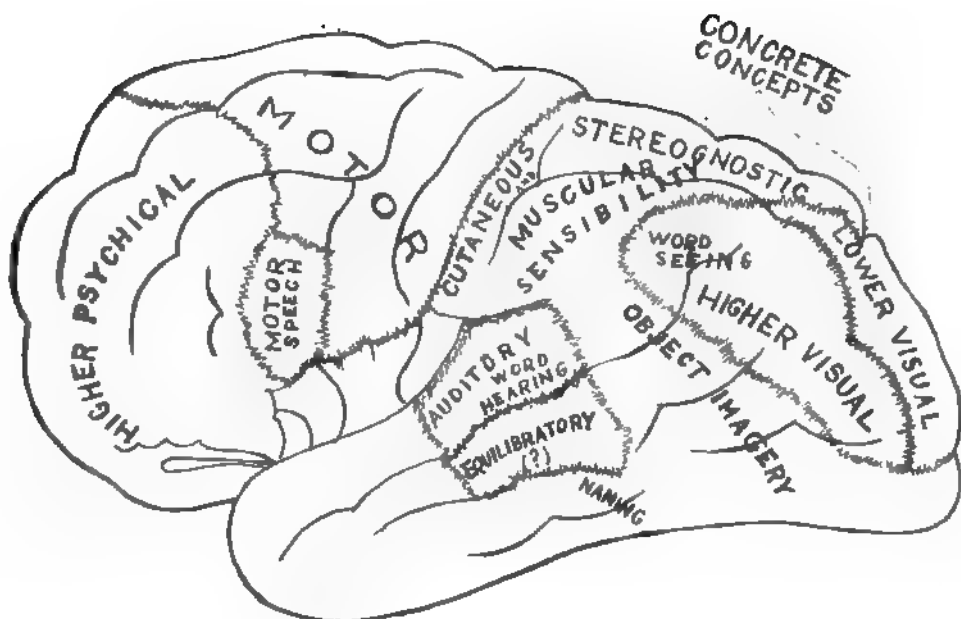


Fig. 9.

DIAGRAM SHOWING AREAS OF CEREBRAL LOCALIZATION.
(Taken from the original drawings by Prof. Chas. K. Mil's.)

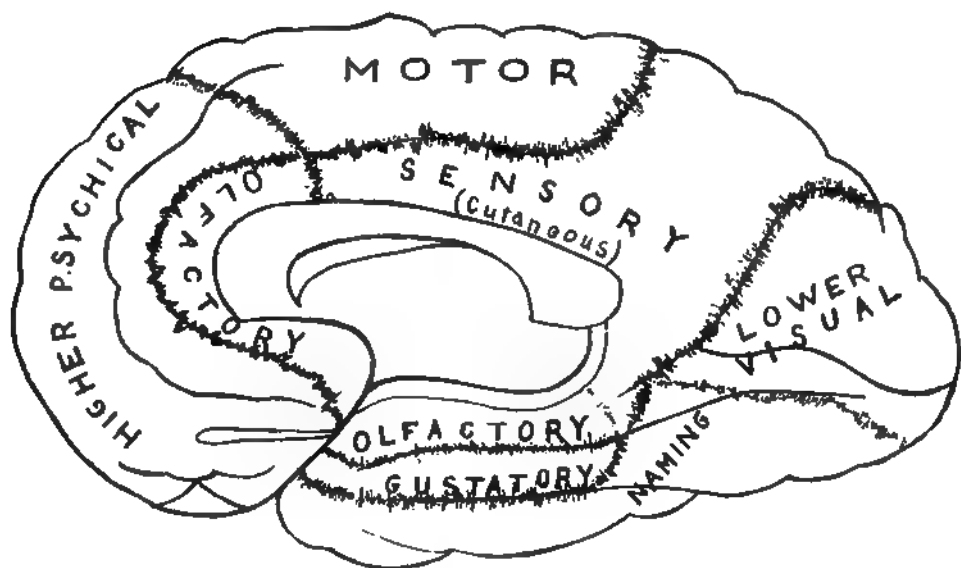


Fig. 10.

DIAGRAM SHOWING AREAS OF CEREBRAL LOCALIZATION
(Taken from the original drawings by Prof. Chas. K. Mills)

SURGERY OF THE HEAD

our own that we have never felt called upon to rest upon or in the matter of locating cerebral conditions independently.

We have, however, always confirmed these diagnoses before opening the skull, simply for the purpose of having a reasonable basis upon which to share the responsibility.

For practical purposes it seems best to obtain a mental picture of the entire brain, and to associate the various areas with their functions, and then to transfer these areas to the surface of the skull.

The accompanying drawings by Prof. Chas. K. Mills, are exceedingly simple and clear, and we have found them most useful in our own clinical work.

There are certain general facts concerning cerebral localization which must always be borne in mind in diagnosing brain lesions, which are, however, so well known that it is scarcely proper to mention them in this place. We refer particularly to the fact that, with the exception of certain muscles like the orbiculares oculi, those of mastication, the larynx, the pharynx, etc., the muscles of the body are controlled by the motor areas of the opposite cerebral hemisphere. There may, however, be a tumor, abscess, or blood clot, in one hemisphere, exerting a sufficient amount of pressure transversely upon the other side to cause symptoms originating in the opposite hemisphere, so that symptoms of paralysis in these rare cases will be found on the side on which the brain lesion exists.

It is further important to remember that these areas of localization are not definitely circumscribed, but that they overlap each other.

TUMORS OF THE BRAIN.

The removal of a fibroma, gumma, and cysts from the brain is frequently followed by permanent recovery of the patient, and as it is usually impossible to make a differential diagnosis between these and malignant growths an attempt at their removal is of course justifiable, because the consequent pressure from benign growths will result seriously to the patient, even if it does not shortly destroy him. Therefore the patient who is suffering from a non-malignant tumor has everything to gain from operative treatment, while the one who suffers from the presence of a malignant growth has nothing to lose and, as will be presently indicated in the discussion of the decompression operation, even this class of patients has much to gain.

Cushing, Mills, Krause and Horsley have demonstrated the possibility of exact localization so constantly and so many times that one can usually be positive concerning the location of cerebral tumors. In our experience Rothstein has been able to indicate the precise location of cerebral growths, so that it has been possible for us to make an osteoplastic flap in each instance from which the growth could be reached.

These flaps are formed according to the method to be described presently in connection with the operation for removal of the Gasserian ganglion.

Experience and Special Training.

At this point it may be well to state that it is not proper to undertake this operation unless a surgeon has had experience in the capacity of assist-

ant to a skillful and careful master. It is quite different from operating for cerebral pressure, due to the presence of a blood-clot caused by hemorrhage from a torn vessel, which is really an emergency operation that cannot wait for a surgeon with special training.

Technique.

Many of these patients lack resistance and consequently the surgeon with the greatest experience and skill, and the best judgment, is none too well-equipped for performing a successful operation. In many, it is best to make the skin and bone flap at the first operation, and then, a few days later, when the patient has recovered from the shock of this step, to complete the work. In the meantime a piece of aseptic gauze is placed underneath the flap and the latter is held in place by means of a few sutures and the entire area covered with an aseptic dressing.

With some experience it is possible to determine which cases should be treated in one and which in two stages.

Hemorrhage is the most troublesome feature in these cases. Only a few of the bleeding vessels can be controlled with hemostatic forceps and ligatures.

Most of the hemorrhage must be controlled with gauze pads wrung out of hot normal salt solution. Even very severe oozing of blood from the cut brain surface can usually be checked by holding one of these pads in contact with the bleeding surface for a period of five minutes. If this does not suffice in giving a sufficient amount of freedom from bleeding, the head of the table should be elevated in order to place the body at an angle of from 40 to 60 degrees with the horizontal plane. If this does not answer, the wound should be tamponed with sterile gauze and the operation completed after an interval of several days.

After the tumor or gumma has been enucleated the cavity should be tamponed with a gauze pad wrung out of hot normal salt solution, and this should be left in place for at least five minutes. If hemorrhage is seen to have ceased when the tampon is removed, the dura and skin flaps should be closed, with the exception of one angle. If hemorrhage has not ceased the cavity should again be tamponed with an aseptic gauze strip and one strand should be passed out of the angle of the wound, which is to be closed as above. A piece of gutta percha tissue should be placed about the part of the gauze passing through the dura and the scalp in order to facilitate its removal a few days later.

DECOMPRESSION OPERATION.

In many cases in which a tumor cannot be removed and in which the patient suffers from pressure symptoms, such as headache, dizziness, nausea, or eye symptoms, as indicated by impaired vision and by the presence of choked disk on ophthalmoscopic examination, he may be greatly benefited by the removal of a large portion of the skull.

A flap is made preferably directly over this location of the tumor. It should include the scalp and the skull together with the dura. If an exploration seems indicated, the dura is not primarily removed, but a crucial incision is made in the dura, which is later closed with catgut sutures, if a removable tumor is found, but otherwise it is cut away at once. The bone flap is

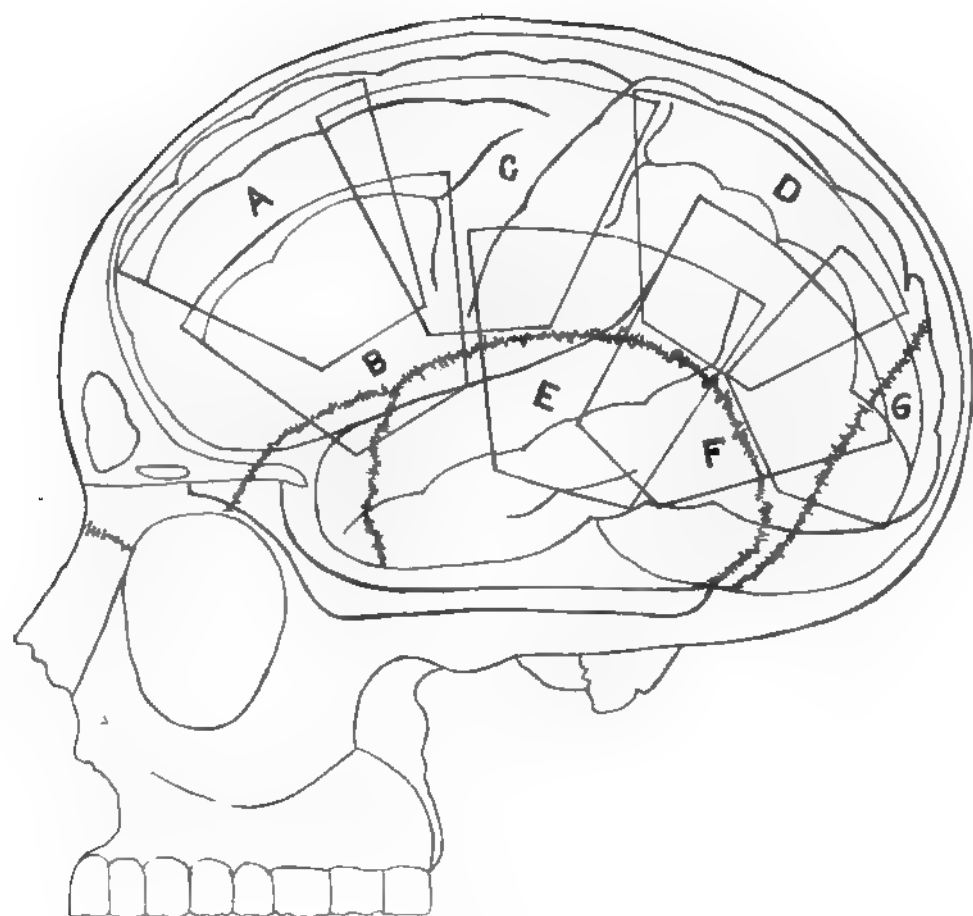


Fig 11.

CRANIAL AREAS FOR OSTEOPLASTIC OPERATIONS

These areas corresponding to the regions of the left hemi cerebrum with definite syndromes

(Taken from the original drawings of Prof Chas. K. Mills)

removed entirely and the skin flap is closed, with the exception of a space of about one cm. at one angle. We have repeatedly observed a marked subjective improvement in the vision in these instances and a disappearance of all of the other symptoms due to cerebral pressure.

In most cases the patients have remained comfortable after this operation until they have suddenly died from hemorrhage or from a perforation of a lateral ventricle, but in each one the patient and his friends have agreed with us in the supposition that the operation had been of marked benefit to the sufferer.

In cases in which it is plain from the start that nothing can be done except a decompression operation, it is perfectly proper that this be undertaken by a surgeon of ordinary skill and without especial experience, but this is never proper in cases in which a surgeon with greater skill might be justified in removing the tumor.

ABSCESS OF THE BRAIN.

What has been said with regard to tumors of the brain, so far as localization and approach through the skull are concerned, may also be applied to cerebral abscess. In these cases there is, however, usually a history of suppuration, most commonly in the middle ear and mastoid cells, and occasionally in the cavities connected with the nose.

Nausea is usually one of the prominent symptoms and there is often, but not always, a rise in temperature at some period during the day.

After exposing the dura by reflecting a bone flap there may be an absence of pulsation and the dura may be edematous, showing that the abscess is superficial. In this event a simple incision with the insertion of a soft rubber drainage tube will suffice.

Should the abscess not be superficial the deep tissues may be explored by the use of an exploring needle, with a closed, moderately-sharp end and a fair-sized hole in the side near the end. It should carry an obturator in order to prevent the brain tissue from clogging the canula. From time to time this should be removed and an aspirating syringe attached; if pus escapes an incision should be made along the side of the exploring trocar and a soft rubber drainage tube inserted. A notch should be cut in the bone flap sufficiently large to prevent compression of the tube, which should be passed out at this point and the wound there closed, sufficient space being left for satisfactory drainage. Irrigation should not be employed. The drainage tube should be left in place until the discharge of pus has ceased.

It should be borne in mind at this point that by far the most important duty of the surgeon is to prevent the formation of cerebral abscesses by early radical treatment of suppuration wherever it may occur, but especially suppuration of the middle ear and of the mastoid cells.

ABSCESS OF THE MASTOID CELLS.

Patients suffering from infection of the mastoid process usually give a preliminary history of some infectious disease affecting the tonsils. This is followed by an infection of the cavity of the middle ear. The abscess of the middle ear may have been drained spontaneously by a perforation of the drum or the latter may have been incised, but there is usually a history of recurrence of this infection or a continuous infection indicated by the

presence of interrupted or continuous discharge from the ear. Following this pain appears behind the ear in the region of the mastoid process. Frequently this pain subsides when the discharge reappears, indicating that drainage has been established from the mastoid process through the middle ear. In other cases the pain steadily increases and is presently followed by the occurrence of edema over the region of the mastoid process, which may extend downwards upon the neck along the course of the deep jugular vein. In rare instances there may be fluctuation in the region of the mastoid process, or even perforation of the abscess, but usually the resistance of the periosteum covering this process is sufficient to prevent these evidences from appearing.

Still later the patient may suffer from diffuse headaches extending over a more or less extensive portion of the head, usually radiating from the site of the infected process. Still later the patient may become comatose or nausea and vomiting may appear, which may be followed sooner or later by coma and death. The explanation of the condition described lies in the fact that the infection has extended from the cavity of the middle ear into the mastoid cells. It has then progressed outward to the periosteum, or through this, or it has extended inward underneath the dura and has caused a more or less diffuse meningitis, sometimes accompanied by a subdural abscess, or it may have extended into the brain—giving rise to a cerebral abscess. These patients are usually seen by the practitioner before the infection has advanced beyond the mastoid cells, and it is at this time that the greatest amount of benefit may come from surgical intervention. At this time the operation is safe, it can be performed by any surgeon with ordinary skill, and the patient is not likely to suffer secondarily as a result. It is quite different if the operation be postponed until there has been a considerable extension of the infection. In such event it is scarcely proper for any one who has not had extensive experience in brain surgery to operate upon these patients, and even with the greatest skill the proportion of recoveries is but slight. In cases operated at the proper time, that is, during the early part of the infection, the drainage which can easily be established will prevent the further infection of the deeper structures, and consequently will make a more extensive operation unnecessary.

It would seem that the presence of pain, together with even a slight amount of edema in the region of the mastoid process, the pain being increased upon pressure, and in any case in which there is a history of previous infection of the middle ear, would be a distinct indication for an operation.

Technique.

A sufficient amount of hair should be shaved off in the vicinity of the mastoid process to prevent annoyance in applying the dressings later on and to prevent the hair from interfering with the progress of the operation. A vertical incision is then made directly behind the ear, one and one-half inches in length, whose center is at a point one-fourth of an inch behind and exactly on a level with the upper margin of the external auditory meatus. This incision should extend down through all the tissues to the bone. The periosteum is carefully reflected and in this manner the mastoid process is exposed.

If the points which have just been mentioned are borne in mind, the operation may be performed with safety by any one, the opening into the

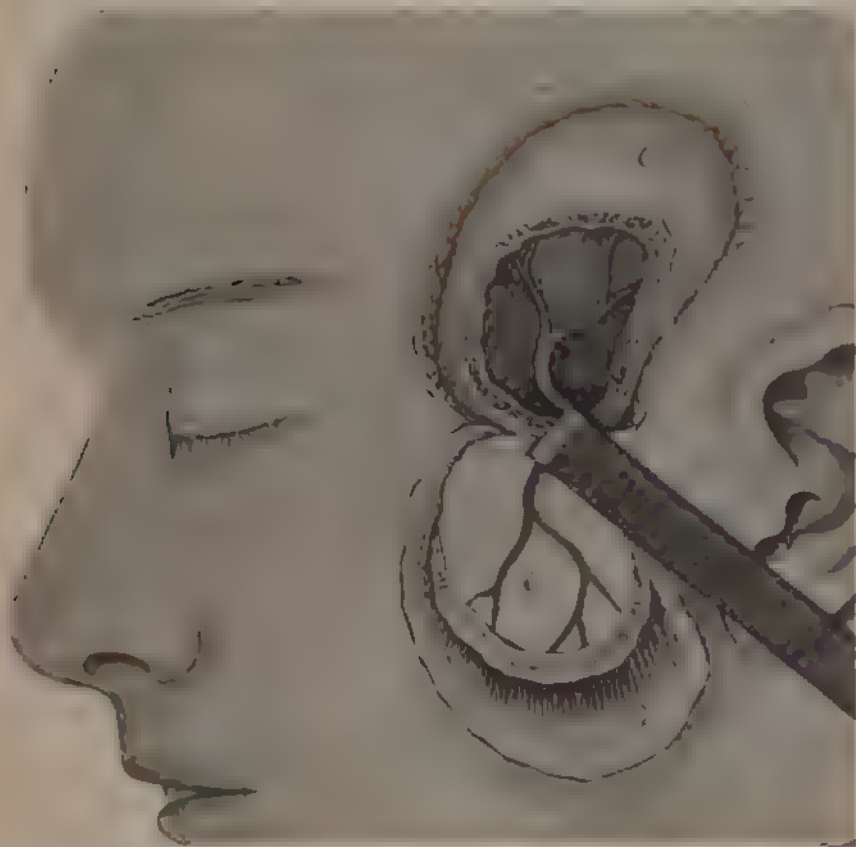


PLATE I

TEMPORARY RESECTION OF THE SKULL.

The elliptical flap of bone *a* remains attached to the flap of the skin, fascia, muscle and periosteum *f*. The latter is represented somewhat too large in proportion to the size of the bone flap. *b* shows the middle meningeal artery with its anterior and posterior branches *c* and *d*. The chisel *c* is in the position in which it was held for the purpose of severing the lower attachment of the bone flap after the horse-shoe shaped groove had been cut with the De Vibiss forceps. The entire flap should be placed a little higher for the purpose of ligating the branches of the middle meningeal artery and somewhat lower for the removal of the Gasserian ganglion.

mastoid cells being made by means of an ordinary carpenter's gouge about one-half inch in diameter.

The dangers of the operation are in opening the meninges above or invading the sinus behind, but if the operator makes his initial opening in the mastoid process at a point on a level with the upper margin of the external auditory meatus and one-fourth of an inch behind the posterior margin, these dangers will be entirely avoided. After the mastoid cells have once been opened the opening can easily be enlarged by chiseling in every direction from this central point. The mastoid cells will be found to contain pus in various quantities from a few drops to one-half a drachm or more. This is carefully sponged away and the external avenue enlarged until it is as large in every direction as the greatest diameter of the underlying cavity, so that the cavity which is left will be conical in shape, with the base of the cone directed upward. Care should be taken not to injure the branch of the facial nerve extending along the edge of the external auditory meatus, but this can be easily done by simply bearing in mind the anatomical position of this nerve and working away from it with the chisel, instead of toward it. The cavity after being thoroughly cleansed, is loosely tamponed with gauze and a dressing applied over it.

The dressing should be renewed at first every day, and later less frequently, the opening in the mastoid being permitted to heal from the bottom by granulation. In advanced cases, and in those in which the infection has existed for a sufficient time to insure the involvement of surrounding tissues, a more extensive operation is indicated, but this should be performed only by those experienced in surgery upon the skull, as the dangers of causing permanent injury are much greater, and the necessity of the operation is not so urgent as in acute mastoiditis; consequently such operations may safely be postponed until the proper preparations can be made. The conditions are, therefore, quite opposite in acute mastoiditis, the operation being simple, safe and strongly indicated at once, while postponement is connected with great danger. In chronic cases the operation is complicated, difficult and dangerous, while postponement is relatively safe.

MASTOID OPERATION IN CHRONIC CASES.

It is difficult to describe this operation so that it can be performed safely by one who has neither accomplished it upon the cadaver nor has seen it done upon the living subject, and we believe, therefore, that this operation is not justifiable unless the surgeon has performed it upon the cadaver.

The incision is the same as in the operation just described; the periosteum is then stripped away toward the external auditory meatus and a blunt periosteotome is passed down between the bony canal of the external auditory meatus and the skin lining this canal, so that the latter is loosened down to the tympanum. The mastoid antrum is then opened, as described in the former operation, and the lower layer of the posterior wall of the bony portion of the external auditory canal is removed with a chisel, so that the external auditory meatus and the cavity in the mastoid form a continuous conical opening. The cavity of the middle ear is then opened and the hammer and anvil are removed by means of forceps. Great care must, of course, be exercised to protect the branch of the facial nerve which passes through the bony wall of the external auditory meatus. The

skin lining the external auditory meatus is then split longitudinally and spread out over the surface of the newly-formed cavity for the purpose of lining this, thus increasing the size of the external auditory meatus greatly. It is held in place by means of a tampon of iodoform gauze.

Use of Beck's Bismuth Paste.

During the past three years we have found that cases in which the infection extends down the Eustachian tube at the time of operation, which causes a reinfection of the wound and a consequent retardation in healing, excellent results may be obtained from dressing the cavity with Beck's bismuth paste, consisting of one part of bismuth subnitrate and two parts of yellow vaseline, applied daily at first and less frequently later on.

Of course by invariably removing the infected tonsils and the adenoids which are located about the ostium of the Eustachian tube conditions are established which are favorable for the spontaneous healing of any suppurating surfaces which may exist in this tube. We have never injected Beck's bismuth paste directly into the Eustachian but it is claimed that this is a safe and beneficial procedure in these cases.

REMOVAL OF THE GASSERIAN GANGLION.

During the past few years this operation has been performed many times by many surgeons so that it is now a thoroughly established procedure. Cushing and Frazier and Krause have discussed their special methods which they have applied in a very large number during this time and for those who are particularly interested in this operation it is well to read the writings of these authors.

Before performing this operation it is most important to do it upon the cadaver remembering well, however, that the chief difficulty in the operation upon the living subject comes from the fact that there is always a certain amount of blood present to obscure the field, and that for this reason the simple directions which follow are often quite difficult to carry out.

Operative Precautions and Technique.

Preparatory to this operation, provision should be made against the occurrence of an injury to the conjunctiva from the fact that the operation is accompanied by paralysis of this portion which prevents the eyelids from protecting the conjunctiva against injury. The conjunctiva is therefore protected temporarily by closing the eyelids by the application of a few fine silk sutures. These are removed at the end of from one to two weeks and then the eye is protected mechanically by the use of a properly adjusted shield. The next step consists in providing for a bloodless operation. This can be accomplished by exposing the common carotid artery and applying to it a properly constructed clamp, which will close the lumen of this vessel without crushing the intima. The pressure should be carefully graded, so that this object may be accomplished with certainty. This however, is possible only in patients in whom arterio-sclerosis does not exist to a marked degree. The hemorrhage comes partly from the middle meningeal artery and partly from the dura, and both of these sources are of course controlled by this temporary closure of the common carotid. A horseshoe-shaped incision one and one-half inches in diameter is then made with its convexity upwards, its lower branches being opposite the lower

border of the zygomatic process, which is temporarily resected, the center of the flap corresponding to a point opposite the Gasserian ganglion. The trephine opening is then made similar to the one illustrated for the ligation of the middle meningeal artery and then by means of the DeVilbiss' forceps a groove is cut in the bone similar in shape to the skin flap, only slightly smaller. The base of this flap is severed by means of a few strokes of the chisel, and then it is elevated and laid downwards, exposing the dura. The portion of the zygomatic process which has been temporarily resected is carried down with this flap and increases the space very considerably. It is best to ligate the middle meningeal artery at once, because this can be done more conveniently before the tissues have been disturbed by the remaining steps of the operation. The dura is now carefully separated to the foramen ovale, then it is elevated between the foramen ovale and the foramen rotundum by means of a blunt instrument. The three branches and the root of the Gasserian ganglion are then elevated, care being taken not to approach the inner side of the Gasserian ganglion until the remaining portion of the isolation has been completed, because of the danger of injuring the cavernous sinus and thus clouding the field of operation for the remaining steps.

The second and third branches of the nerve are then severed and the Gasserian ganglion grasped by means of forceps and forcibly loosened from its attachment. In case there is still a considerable amount of oozing a warm, moist gauze tampon is applied and left in place undisturbed for at least five minutes. It is then slowly removed and the clamp upon the carotid artery is slowly loosened. If hemorrhage occurs, which is not likely unless the middle meningeal artery has not been properly ligated, the clamp is again tightened carefully until the flow ceases and the bleeding points are caught and ligated with fine cat-gut, if this is possible, otherwise a small iodoform gauze tampon is applied and held in place. This, however, is not often necessary. The flap is then replaced and the skin sutured, care being taken to pass the stitches entirely through the scalp in order to stop bleeding from the scalp wound after the clamp is loosened. No attention is paid to the resected zygomatic process unless it refuses to stay approximately in its right position. In that case it is held in place by a few cat-gut sutures. During this portion of the operation the patient is permitted to awaken and is placed in the vertical position. The dressings are applied and carefully bandaged. It is well to place a light gauze pad over each eye and to apply a loose bandage over this, because in this way the eye on the normal side will remain quiet and with its fellow will remain undisturbed. If the normal eye is left open the other eye will be compelled to move with every motion of the normal one, and consequently it will be likely to be disturbed unnecessarily.

This operation in the hands of all operators together has given a considerable mortality, probably exceeding twenty per cent, while in the hands of a few surgeons who have carefully developed technique the mortality has been exceedingly small.

We have found it advantageous to administer one-fourth of a grain of morphia hypodermically to these patients half an hour before beginning the administration of the anesthetic, then to anesthetize with ether by the drop method until the patient is very thoroughly unconscious and then to stop the further administration of the anesthetic just before beginning the

skin lining the external auditory meatus is then split longitudinally and spread out over the surface of the newly-formed cavity for the purpose of lining this, thus increasing the size of the external auditory meatus greatly. It is held in place by means of a tampon of iodoform gauze.

Use of Beck's Bismuth Paste.

During the past three years we have found that cases in which the infection extends down the Eustachian tube at the time of operation, which causes a reinfection of the wound and a consequent retardation in healing, excellent results may be obtained from dressing the cavity with Beck's bismuth paste, consisting of one part of bismuth subnitrate and two parts of yellow vaseline, applied daily at first and less frequently later on.

Of course by invariably removing the infected tonsils and the adenoids which are located about the ostium of the Eustachian tube conditions are established which are favorable for the spontaneous healing of any suppurating surfaces which may exist in this tube. We have never injected Beck's bismuth paste directly into the Eustachian but it is claimed that this is a safe and beneficial procedure in these cases.

REMOVAL OF THE GASSERIAN GANGLION.

During the past few years this operation has been performed many times by many surgeons so that it is now a thoroughly established procedure. Cushing and Frazier and Krause have discussed their special methods which they have applied in a very large number during this time and for those who are particularly interested in this operation it is well to read the writings of these authors.

Before performing this operation it is most important to do it upon the cadaver remembering well, however, that the chief difficulty in the operation upon the living subject comes from the fact that there is always a certain amount of blood present to obscure the field, and that for this reason the simple directions which follow are often quite difficult to carry out.

Operative Precautions and Technique.

Preparatory to this operation, provision should be made against the occurrence of an injury to the conjunctiva from the fact that the operation is accompanied by paralysis of this portion which prevents the eyelids from protecting the conjunctiva against injury. The conjunctiva is therefore protected temporarily by closing the eyelids by the application of a few fine silk sutures. These are removed at the end of from one to two weeks and then the eye is protected mechanically by the use of a properly adjusted shield. The next step consists in providing for a bloodless operation. This can be accomplished by exposing the common carotid artery and applying to it a properly constructed clamp, which will close the lumen of this vessel without crushing the intima. The pressure should be carefully graded, so that this object may be accomplished with certainty. This however, is possible only in patients in whom arterio-sclerosis does not exist to a marked degree. The hemorrhage comes partly from the middle meningeal artery and partly from the dura, and both of these sources are of course controlled by this temporary closure of the common carotid. A horseshoe-shaped incision one and one-half inches in diameter is then made with its convexity upwards, its lower branches being opposite the lower

border of the zygomatic process, which is temporarily resected, the center of the flap corresponding to a point opposite the Gasserian ganglion. The trephine opening is then made similar to the one illustrated for the ligation of the middle meningeal artery and then by means of the DeVilbiss' forceps a groove is cut in the bone similar in shape to the skin flap, only slightly smaller. The base of this flap is severed by means of a few strokes of the chisel, and then it is elevated and laid downwards, exposing the dura. The portion of the zygomatic process which has been temporarily resected is carried down with this flap and increases the space very considerably. It is best to ligate the middle meningeal artery at once, because this can be done more conveniently before the tissues have been disturbed by the remaining steps of the operation. The dura is now carefully separated to the foramen ovale, then it is elevated between the foramen ovale and the foramen rotundum by means of a blunt instrument. The three branches and the root of the Gasserian ganglion are then elevated, care being taken not to approach the inner side of the Gasserian ganglion until the remaining portion of the isolation has been completed, because of the danger of injuring the cavernous sinus and thus clouding the field of operation for the remaining steps.

The second and third branches of the nerve are then severed and the Gasserian ganglion grasped by means of forceps and forcibly loosened from its attachment. In case there is still a considerable amount of oozing a warm, moist gauze tampon is applied and left in place undisturbed for at least five minutes. It is then slowly removed and the clamp upon the carotid artery is slowly loosened. If hemorrhage occurs, which is not likely unless the middle meningeal artery has not been properly ligated, the clamp is again tightened carefully until the flow ceases and the bleeding points are caught and ligated with fine cat-gut, if this is possible, otherwise a small iodoform gauze tampon is applied and held in place. This, however, is not often necessary. The flap is then replaced and the skin sutured, care being taken to pass the stitches entirely through the scalp in order to stop bleeding from the scalp wound after the clamp is loosened. No attention is paid to the resected zygomatic process unless it refuses to stay approximately in its right position. In that case it is held in place by a few cat-gut sutures. During this portion of the operation the patient is permitted to awaken and is placed in the vertical position. The dressings are applied and carefully bandaged. It is well to place a light gauze pad over each eye and to apply a loose bandage over this, because in this way the eye on the normal side will remain quiet and with its fellow will remain undisturbed. If the normal eye is left open the other eye will be compelled to move with every motion of the normal one, and consequently it will be likely to be disturbed unnecessarily.

This operation in the hands of all operators together has given a considerable mortality, probably exceeding twenty per cent, while in the hands of a few surgeons who have carefully developed technique the mortality has been exceedingly small.

We have found it advantageous to administer one-fourth of a grain of morphia hypodermically to these patients half an hour before beginning the administration of the anesthetic, then to anesthetize with ether by the drop method until the patient is very thoroughly unconscious and then to stop the further administration of the anesthetic just before beginning the

operation, the patient's head being elevated by placing the table in the inverted Trendelenburg position. The anemia of the brain caused by this procedure serves to keep the patient unconscious until the operation has been completed and reduces the amount of bleeding to a marked extent.

It may be well to caution the surgeon against the careless use of the retractor in lifting the cerebrum. A spatula-shaped retractor is usually held by an assistant for this purpose and unless he has been very carefully cautioned there is danger of his traumatizing the brain tissue during the excitement of the operation. This part of the work should be given to a thoroughly competent assistant.

Shock due to avoidable traumatism is undoubtedly the cause of more deaths during or following this operation than any other one condition, which accounts for the difference in mortality at the hands of otherwise equally competent surgeons.

RESECTION OF PORTIONS OF THE FACIAL NERVE FOR THE RELIEF OF NEURALGIA.

During the early portion of an attack of trifacial neuralgia usually only one of the principal branches is involved. The most common one, in our experience, has been the submaxillary branch.

Internal Treatment and Dietary.

In all cases of trifacial neuralgia, without regard to the portion of the nerve involved, it is wise always to subject the patient first to carefully directed internal treatment. In a considerable proportion of these cases the affection seems to be due to an auto-toxemia from the alimentary tract. In these cases the daily use of from two to four ounces of castor oil, given in the foam of beer, will result in a permanent cure in at least one-half of all instances. At first the oil will act as a violent cathartic, but this property soon disappears, and after a few weeks the patient may continue to take this amount of castor oil daily without any disturbance of the bowels.

In the meantime these patients should be cautioned against the use of food which is likely to cause undue fermentation. Sugar should be prohibited entirely. Starchy foods should be limited, and acids should be used very sparingly. In case this and other forms of treatment fail to give relief to the patient the excision of a portion of the affected nerve is indicated. During the past few years a number of surgeons have advised the excision of the Gasserian ganglion for the relief of all facial neuralgias without regard to the branch involved. This seems, however, scarcely justifiable, because in many cases in which only a portion of the affected branch has been excised the patient has recovered completely and permanently; and if a complete recovery does not occur, it is still possible to perform a radical operation.

Injection of Alcohol.

During the past few years we have obtained excellent results in many cases by injecting 1 per cent cocain in 85 per cent alcohol directly into the nerve sheath, or as near the nerve as possible. This should be repeated once a week until the pain ceases to return. Sometimes one injection will suffice but more frequently it is necessary to repeat this several times. It may be necessary to inject as often as five or even ten times. In cases

which are relieved by this method one can usually count on freedom from pain for at least one year when the treatment may be repeated sometimes with equally satisfactory results.

In the meantime the patient should be under strict supervision regarding the state of his general health. His diet and hygiene should be carefully controlled. The food should be consistently chosen, thoroughly masticated, and absorption of products of decomposition from the contents of the alimentary canal should be prevented. The urine should be examined at regular intervals, especially for the presence of indican.

The condition of the patient's teeth should be made as nearly perfect as possible, and all other influences affecting the patient's general health should be carefully controlled.

Technique.

In order to succeed it is well to have a human skull at hand at the time of the operation, inasmuch as this gives the operator a better idea of distance and direction than he can have otherwise.

It is also advisable to inject methyl blue experimentally in the cadaver in order to gain accuracy in actually reaching the nerve.

Especially needles 10 cm. long, 1 mm. or 1½ mm. in diameter, containing a stylet, can be obtained from the instrument makers to be used in this operation, but different surgeons prefer needles of different thickness and style, the important point being to secure a needle that will penetrate the deep tissues in the exact direction intended by the operator. If the injection fails to give relief and if the area supplied by the branch injected is not analgesic after the mixture has been forced into the tissues, it is certain the nerve has not been reached. In this event it is best to force the needle in a little farther and to inject 2 cc. more of the fluid. If this again fails the needle should be withdrawn slightly and more of the fluid should be injected at various points. If this, in turn, is ineffectual it is best to withdraw the needle and to bear in mind the direction of its employment and then to repeat the injection in a slightly different direction after a few days. It is not wise to risk tearing the tissues by pushing the needle in different directions at one sitting.

Injection of the Inferior Branch of the Fifth Nerve. The needle is inserted at the lower border of the zygoma, one inch in front of its descending root, which is near the anterior long border of the external auditory meatus.

The needle is directed a little backward and slightly upward, so as to hug the base of the skull, and it should reach the nerve at its exit from the skull at a depth of 4 cm.

The Middle Branch. Draw a line from the posterior border of the ascending process of the malar bone to the lower border of the zygoma. Insert the needle .5 cm. posterior to this point, directed so that it would reach the foramen rotundum in the skull you have for comparison. The nerve is reached at a depth of 5 cm.

The Supraorbital Branch. Inject from the supraorbital notch or foramen.

Osmic Acid Injections.

This method has been almost entirely discarded since the introduction of the injection of alcohol. It differed from the latter in the fact that the

diseased nerve was laid bare at the most available point and a few drops of osmic acid injected directly into the nerve. The results were no better than those now secured from the injection of alcohol, and no more permanent, hence the latter method must be preferred because of its ease and safety of application.

RESECTION OF THE INFERIOR DENTAL AND LINGUAL NERVES.

In our practice these two branches have always suffered simultaneously, so that we have never been forced to operate only upon one or the other singly.

Both of these nerves may be approached conveniently through an opening in the lower jaw. An incision is made along the lower border of the jaw, beginning at a point a little behind the angle and extending forward an inch and a half. This incision is carried down to the bone. The periosteum, together with the attachment of the masseter muscle, is then pushed upwards by means of a chisel and an opening one-fourth of an inch in diameter is made exactly in the middle of the ascending ramus of the jaw by means of a small trephine or a gouge. This will expose the inferior dental nerve. The nerve is picked up with forceps and drawn out through this opening. Then a pair of hemostatic forceps is placed upon the nerve and gentle traction made forwards and downwards to loosen it as much as possible. A second incision is then made directly opposite the mental foramen. The mental nerve which issues from this foramen is readily found. It is picked up on an elevator and severed. The portion between the mental foramen and the trephine opening is then drawn out of this opening. Traction is then made upon this portion of the nerve and as much as can be drawn out of the foramen is cut off. In such manner the entire portion of the nerve within the canal in the lower jaw is removed. A small, blunt hook is then inserted through the foramen and passed around the lingual nerve, which is drawn out through the trephine opening, caught with hemostatic forceps, and as much as can be drawn out by pulling upwards and downwards repeatedly, is withdrawn through the trephine opening. It is then cut loose on the distal side and then the nerve is again caught with a pair of artery forceps, which are twisted slowly, so that the nerve is rolled upon the forceps like the rope upon a windlass. In this way a considerable portion of the nerve can usually be drawn out.

We believe that in our early cases we failed to remove a sufficient portion of each nerve, and consequently experienced recurrence in some of these cases, much more frequently than we have since performing this more thorough operation.

RESECTION OF THE INFRAORBITAL NERVE.

The infraorbital nerve is the most common seat of trifacial neuralgia, according to statistics found in literature, but in my own experience it has been less frequent than in the inferior maxillary branch.

The simplest method of approaching this nerve consists in making an incision along the lower edge of the orbit three-fourths of an inch in length, directly over the infraorbital foramen, which can readily be located by making pressure along this margin of the orbit and determining the most painful point. Care should be taken to make this incision slowly, in order

not to sever the infraorbital artery at the point at which it issues from the foramen, as this would cloud the field of dissection with blood. The three branches—the supramaxillary, sphenopalatine and infraorbital nerves—usually do not separate before issuing from this foramen, but caution should be observed in making the dissection not to overlook one or the other of these branches in case division has taken place before exit from this foramen.

When the nerve has been laid bare it should be picked up on a dissector. (And we would state here that the most convenient instrument for dissecting out nerves which we have encountered is the old-fashioned dental excavator, which is fine enough to serve properly and still contains sufficient strength to be useful.) If the foramen is complete its upper portion is chiseled away, transforming it into a groove. The nerve is then grasped with a pair of hemostatic forceps and drawn upward, and its branches are followed with a dissector and successively cut away at a distance of about three-fourths of an inch from the foramen. Careful traction, which is frequently repeated, is then made upon the nerve with the forceps. In this manner more and more of the nerve can be withdrawn.

If the neuralgia has been severe it is well to chisel away the upper wall of the canal with a blunt raspatory after loosening the periosteum overlying it. A narrow retractor is then inserted underneath the periosteum and while traction is made upon the nerve a narrow pair of scissors is inserted and the nerve is cut off a considerable distance from the infraorbital margin.

EXCISION OF THE SUPRAORBITAL NERVE.

The operation which has just been described is also performed for the relief of supraorbital neuralgia, with the exception of making an incision along the supraorbital margin after shaving away the eyebrow. If the incision is made directly through the middle of the eyebrow, and parallel to it, it leaves no deformity.

These three operations are relatively simple and safe. They give rise to no deformity, and unless the antrum of Highmore is opened in chiseling open the infraorbital canal the wounds all heal rapidly and perfectly. In case any one of these procedures has been performed and there is a recurrence of the neuralgia the undertaking may be repeated and a second attempt may result more favorably. If, however, a radical cure of the condition is desired, then it is best to excise the Gasserian ganglion.

HARE-LIP.

Best Time for Operating and Preparation.

In uncomplicated cases of hare-lip the sooner the operation is performed, the better it is for the infant. This should be done some time during the first ten days. In cases associated with cleft palate, especially if this be complete, it is better to follow the method devised by Brown, which consists of placing a strip of zinc oxide adhesive plaster across the lip fissure, making it about the width of the upper lip and extending sufficiently across the cheek from each side to give firm resistance when tightly drawn. The strap is reapplied daily until the operation is performed.

The advantages of this preliminary treatment are that it not only pre-

vents an increase of deformity and further distortion of the face by unnatural muscular action, but it has a tendency to correct the deformity, as in crying and laughing the principal force of muscular action is applied to the most prominent anterior portion of the maxillary bones, which in double hare-lip and cleft palate is the mandibular process.

It also has a decided effect in the single cases, as in all of them the maxillary is more prominent on one side than on the other, and the strap has the tendency to depress the more prominent side and to bring the shorter side forward. Furthermore, the infant becomes accustomed to take nourishment with the lip in a condition similar to that after operation and to breathe through the reduced air space. After the daily application of the adhesive straps for a period of ten days or two weeks, the above advantages will have been gained and the defect in the lip should be closed.

Technique.

The steps of the operation should be planned so that after closure of the fissure there will be practically no scar and as little deformity of the lip as possible. The freeing of the lip from the cheek is one of the most important parts of the operation, for unless this is thoroughly done it will be impossible to bring the edges of the lip together without tension, which is apt to result in a failure of union, or in the production of scars caused from cutting of the tissues by the stitches.

After the lip has been thoroughly loosened the edges of the cleft in the lip must be prepared for suturing. This is accomplished by using a very sharp, thin-bladed scalpel, with which a thin strip of tissue is excised from the border of the lip on each side of the fissure. The dissection is commenced at the upper border of the lip and carried downwards, removing a very thin layer of tissue. The mucous membrane from the lower one-half centimeter of the lip is not excised, but is left as a wedge-shaped projection at each corner of the lip. When the lip is sutured these two wedge-shaped corners are brought together and form a slight projection downwards, which will prevent the formation of a notch as the scar contracts. This also helps to broaden the lip.

If the lip is too narrow, it may be broadened by making a curved incision in excising the mucous membrane, having the convexity of the incision toward the cheek on each side, thus removing only a thin strip of mucous membrane at the upper and lower corners, and a strip about one-half centimeter wide from the center of the lip. As the two concave surfaces are brought together it will broaden the lip. In closing the lip the sutures should be placed with great care and without tension. Two tension sutures of silkworm gut threaded in a fine needle should be placed first. The needle enters the skin about one centimeter from the edge and is carried in an oblique direction and emerges from the lip just at the edge of the mucous membrane or the posterior surface of the lip. It is then passed into the edge of lip on opposite side, entering at the edge of the mucous membrane and emerging at a point one centimeter from the border on the skin surface. These two sutures are left untied until the coaptation sutures have been placed.

The mucous membrane of the lip is now sutured with fine catgut throughout, and the edges of the skin coaptated by placing a few horse-hair stitches. The tension sutures are then tied, but care should be given not to tie them too tightly. Adhesive strips should now be applied, so as to take

all the tension away from the stitches. The stitches should be removed at the end of a week, but the adhesive strips should remain in place for two or three weeks.

DOUBLE HARE-LIP.

In cases in which the prolabium has been left, it is usually advisable to depress this projection somewhat, and then utilize it as a central island in the formation of the new lip. The mucous membrane should be dissected off of the three borders of the prolabium, and from the two borders of the lip. An incision about one-half centimeter long should be made in each lip a little below its center and at right angles to its freshened edge. The upper half of the lip is now sutured to the lateral borders of the prolabium, and the edges of the "land" half of lip are sutured to each other in the mid line and above to the lower border of the prolabium.

CLEFT PALATE.

If a hare-lip is associated with a cleft palate, the lip should be repaired immediately or some time during the first three weeks of life, and the cleft in the palate left until some later time.

Differing Opinion as to Best Time of Operating.

Authorities are evenly divided on the question of time for operating for closure of the palatine cleft; many of them recommend that the palate be closed in infancy, and this done before closure of the hare-lip. The advocates of the early operation advise that the palate should be closed during the first three months after birth; that there is less shock at this time of life because the child's nervous system is not fully developed; that there will be the minimum amount of deformity, for they claim that all of the tissues, both bony and soft, will develop more naturally after the cleft is closed, and that this development will allow a normal speech to follow when the child reaches a speaking age.

The question of mortality in these infants is an important one. There is no doubt but that these little patients are better able to stand an operation of this kind at the age of eighteen months, than they are during the first few months of life. Furthermore, children during their first year are more subject to toxemias than older ones and are apt to develop intestinal troubles following the operation, which are likely to add to the mortality. It is the author's custom to close only the fissure in the alveolar process before the age of eighteen months and to leave the remaining portion until such time as the child makes an attempt at talking. We also caution the parents of such children against encouraging them in these attempts, because our results have been more satisfactory when the operation was performed at the age of eighteen months or two years than when the operative repair was attempted in very young children; moreover, the mortality in children at this age has been practically nothing, while in those younger it has been considerable. In older children it is difficult to secure perfect speech unless great pains is taken in giving them instruction.

Effect of Training Upon Speech.

The following observation, however, has convinced us that it is possible to get these children to speak very nearly perfectly if a sufficient amount

of care and patience is employed. If children should have learned a given language before the operation was performed and have later learned another language, we have found that the language which they learned later was spoken perfectly, while the defects noted in the language learned before the operation were likely to persist. It is consequently plain that if these children were taught to relearn their language that with care they could accomplish a great deal. This we have found to be true in practice and we would consequently advise a systematic course of instruction in the formation of those sounds in the utterance of which the soft palate is involved. Some especially gifted teachers have succeeded in producing perfect results whenever the child has possessed a sufficient amount of intelligence to appreciate the instruction and the necessary perseverance to carry it out.

Technique.

Certain conditions are obviously necessary in order to insure success from any of the various operations which have been devised for closure of cleft palate, namely: The naso-pharynx must be in a fairly healthy condition; the operator must prepare broad edges of the flaps to be united; the flaps must be sutured carefully and without tension; one must traumatize the tissues as little as possible; must keep the parts as clean as possible after operation, and it is important to keep the parts relatively quiescent after operation.

The success of this operation depends largely upon the thoroughness with which the flaps are loosened, and if the surgeon appreciates the fact that his operation is not likely to succeed so long as there is any tension upon the stitches which unite the edges of the wound in operations for the relief of cleft palate, he has grasped the most important principle in this operation. The method of the operation will vary with the extent of the cleft. If this is only through the soft palate, it is wise to split the edge of the cleft throughout its entire extent, beginning at the tip of the uvula on one side, extending this incision around the entire cleft to the tip of the uvula on the other side. This produces a broad surface for coaptation. It is necessary to make use of an exceedingly sharp scalpel in order to accomplish this incision satisfactorily. After this has been accomplished, a method must be adopted for loosening the flaps on either side so thoroughly that they will come together without the slightest tension. This can be brought about by making two lateral incisions along the outer edge of the palate and loosening the soft tissues by means of an elevator, or a small chisel may be applied to the alveolar process of the palate bone and this may be chiseled off, as shown in the drawing.

It matters little how large an incision or opening is made upon each side, provided the flaps can be sufficiently freed so that they will come together without injury. The lateral incisions will invariably heal spontaneously.

Involvement of Hard Palate.

In case the cleft extends into the hard palate, or through the hard palate, the following method has been most satisfactory in our hands, although it is more troublesome than some of the other procedures that have been found equally useful by other surgeons. The incision is made under the alveolar process on each side. A broad, thin chisel is placed in this incision and the horizontal portion of the palate is chiseled away so that there is a



PLATE II.

CLEFT PALATE OPERATION

(a) Shows sutures on mucous membrane turned into nasal cavity; (b) sutures on flap turned into the cavity of the mouth; (c) the silkworm gut suture which holds together the bone flaps; (d) flap turned into the nasal cavity; (e) flap turned into cavity of mouth; (f) incision through hard palate. In order to make the conditions clear the drawing was made to represent only the lower surface of the upper jaw with the hard and soft palate.



perfectly loose flap consisting of mucous membrane of the mouth, the bone of the palate and the mucous membrane of the nasal cavity attached only in front and behind. If one side or the other is attached to the vomer this attachment is also loosened. If this flap is made so loose on each side that it can be carried over to the flap on the other side without the use of any force, then one may usually count on a successful result.

Hemorrhage.

The hemorrhage in this operation is considerable, but it can readily be controlled by means of a tampon. The patient is in the Trendelenburg position, with the head projecting beyond the table, consequently there is no danger of the inspiration of blood. After these flaps have been made the fissure which has been formed under the alveolar process should be thoroughly tamponed with iodoform gauze and the flaps should remain undisturbed for one or two weeks, the nose and mouth being frequently irrigated each day with normal salt solution. At the end of this time the flaps are usually very vigorous and readily heal if the edges are freshened in the manner we have just described in connection with operation for cleft of the soft palate.

Sutures.

The most satisfactory suture material in our practice has been horse-hair, because it is slightly elastic, stretching sufficiently to prevent pressure necrosis. Of course, it is necessary not to tie these sutures tightly as the same elasticity which would be useful if these sutures are tied loosely would then become harmful, for it would increase the amount of pressure necrosis precisely after the manner of an elastic ligature. It is well to remember that the fewer the number of sutures that will suffice to secure perfect apposition the greater will be the likelihood of union.

In order to hold the bony portion of the flaps in position it is well to pass around them one or two stitches of silkworm gut, which should be tied just tightly enough to hold the tissues together and not tightly enough to cause pressure necrosis, because the latter condition is likely to result in a complete severing of one or both bony flaps. The fissures under the alveolar process should again be carefully tamponed with iodoform gauze. If the fissure extends through the alveolar process in front, this should be mobilized on either side some distance back from the fissure by means of a chisel applied between the teeth, and then the edges should be united at the point of fissure by means of a catgut suture.

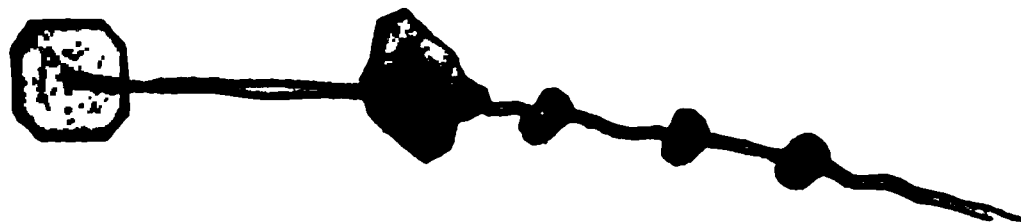
In children who are not old enough to remain perfectly quiet during the removal of the stitches it is best to administer an anesthetic when the stitches are removed, for fear of disturbing the line of union. If possible the sutures should be extracted on the fifth or sixth day, as if they are left longer they sometimes result in sloughing.

Brown Operation.

Of late the authors have been doing the operation as devised and practised by Dr. G. V. I. Brown, and with excellent results.

The operation is based upon the fact that all of these patients have a high arch, which increases the diameter of the mouth, and that by lowering the roof of the mouth the necessary width for closing the fissure is obtained. The technique is as follows: A short incision is made along the margin of the alveolar process, extending down through the periosteum of

the hard palate. A small, thin chisel is then inserted down to the bottom of this incision and the tissues of the roof of the mouth, together with the periosteum of the palate bone, are thoroughly loosened from the edge of the cleft back to the alveolar process. Both sides are treated in the same manner. The edges of the palate tissue are now carefully trimmed off in a manner so as to secure broad surfaces for coaptation. A fine silver wire, with a silver plate about one centimeter in diameter fastened to one end, is now passed through the flap on one side at a point about one centimeter from its inner margin, and then carried across and brought up through the opposite flap at a corresponding point, and left loose until the coaptation sutures have been placed. The edges of the two flaps are now very carefully united by horse-hair or fine silk stitches, being very cautious not to draw them tight. A silver plate about a centimeter in diameter is now threaded upon the free end of the silver wire, and then three or four drilled shot are threaded down on top of the plate. The object of using several of the shot is to be able to obtain the exact tension desired on the silver stitch. The outermost one of the shot is now crushed, and then the tissues tested for the desired tension. If the tension is not enough the other three shot are pushed down a little and the next are crushed on to the wire. As soon as the desired tension is secured the innermost shot is crushed and the superfluous wire together with the other three shot are removed. It is usually necessary to make one or two lateral incisions



Plates and shot threaded on silver wire.

through the flaps along the alveolar process in order to relieve any possible tension that may be present. The stitches should be left in place about seven to ten days, cleansing and spraying daily.

FISTULAE FOLLOWING OPERATION.

It happens occasionally that a fistula remains in some portion of a wound which has been sutured. This may be due to the cutting of a stitch or there may have been a certain amount of tension which prevented union, or there may have been a slight amount of infection. If these fistulæ are painted every day with tincture of cantharides they are likely to unite very rapidly. If they fail to unite after this treatment has been tried for several weeks it is best to leave the fistula for a number of months until the surrounding tissues have become quite normal and then to make a longitudinal incision on each side of it and to loosen enough of the soft tissue to permit the two sides to come together in mid-line without any tension. These incisions should be long enough to make the flaps perfectly free. Then the fistula is freshened and united by means of a stitch. Occasionally it seems better to make a horseshoe-shaped incision around one or the other end of the fistula and thus to loosen a one-sided flap which will heal directly over the opening.

EMPYEMA OF THE ANTRUM OF HIGHMORE.

For the relief of an empyema of the antrum of Highmore the most

convenient and satisfactory point of approach is through the canine fossa. A longitudinal incision is made parallel with the alveolus of the upper jaw, two centimeters in length, at the point at which the mucous membrane extends from the jaw to the cheek. The periosteum is elevated for a distance of two centimeters and is held out of the way by means of retractors. Then an opening one and one-half centimeters in diameter is made by means of a gouge, the ordinary carpenter's chisel and mallet again being used. The cavity is then carefully curetted, first with a large and then with a small curette; then it is repeatedly sponged out with a dry gauze sponge, which will remove any granulations or remnants of polypi. Then the entire cavity is sponged with a piece of gauze slightly moistened with ninety-five per cent carbolic acid, or, better still, the entire cavity is tamponed full of a strip of gauze moistened in this manner. This tamponing is repeated a number of times, so that all the lining of the cavity of the antrum has been kept in contact with the strong carbolic acid for a period of about five minutes. Then it is tamponed several times with a strip of gauze saturated with strong commercial alcohol in order to wash away any superfluous carbolic acid. After this the cavity is tamponed with iodoform gauze saturated with tincture of benzoin. This may be left in place for a number of days, the antiseptic qualities of benzoin being sufficient to prevent the cavity from becoming foul. After this has been removed it is usually sufficient to insert a small self-retaining rubber cannula through which the antrum may be irrigated daily with some mild antiseptic fluid. If the infection of the antrum has not been of long standing it is not necessary to make so radical an operation, the simple opening, irrigation and drainage of the cavity often sufficing.

In old cases it is well to remove the separating bony wall into the nose for permanent drainage and for the purpose of obtaining an easily accessible opening through which the cavity may be cleansed.

Beck's Bismuth Paste.

Since the introduction of Beck's bismuth paste we have had excellent results in the after-treatment of these cases by tamponing the cavity with gauze filled with this paste once in two or three days, and later by injecting the paste through the artificial opening and then closing this opening with a small gauze tampon. This treatment is repeated daily at first and less and less frequently later on.

Mild cases will recover if the antrum is filled in the same manner with Beck's bismuth paste through a cannula introduced through the nose, without making an artificial opening into the antrum, the nostril being tamponed with gauze after filling the antrum.

Except in cases of very long standing it is advisable to try this method first, for a few weeks, instead of at once choosing the operative treatment. In case the antrum contains neither polypi nor necrosed bone the suppuration decreases rapidly and then the injection should be made less frequently. It is wise, however, to inject the bismuth paste once a week after the condition seems normal.

EMPYEMA OF THE FRONTAL SINUS.

The treatment which has just been described for empyema of the antrum of Highmore is equally applicable to the above condition.

After thoroughly disinfecting the nose a cannula is carried up into the

affected sinus and the latter is filled with Beck's bismuth paste under very moderate pressure, the paste being heated to 110° F. It is important to inject the fluid slowly and to continue the injection for several minutes in order to fill every portion of the cavity. In case it is not possible to pass a cannula of about 2 mm. diameter through the nose into the frontal sinus a passage should be made with a fine bone curette, or, if this is not possible, with a fine gouge. This can be done under local anesthesia with cocaine or general anesthesia with ether may be employed.

After the sinus has been filled with the bismuth paste the nasal cavity is tamponed with gauze which has also been saturated with the paste which will serve to keep this cavity as nearly aseptic as possible.

INFECTION OF ETHMOID CELLS.

In many cases this affection precedes, accompanies or follows the condition just discussed. The treatment in these cases depends, as in the two previous diseases, upon disinfection and drainage, the latter in most instances accomplishing the former. Recently operations upon these cells have been undertaken in many cases which would undoubtedly have recovered perfectly and permanently without the necessary defect following an operation had the patient's general state of health been more carefully directed. This is especially true regarding habitual errors in respiration in many of these patients. Their breathing is habitually so shallow that they never either fairly fill or empty their lungs, and consequently leave the mucous surfaces constantly congested. By instructing them to inhale to their fullest capacity and then forcibly blow out the air through a small glass tube until their lungs are as nearly empty as possible, doing this many times a day, these surfaces clear up rapidly and in early cases, if this practice be continued, we have seen many who have remained permanently well, so far as their ethmoid cells were concerned, while their general health was vastly improved. Of course the diet and habits of work and sleep, as well as the ventilation of living and sleeping rooms, must be regulated at the same time.

Technique.

Under local anesthesia with two to five per cent cocaine injected through a fine long needle, it is possible to secure satisfactory drainage by curetting away the infected cells with a strong, fine, sharp curette, or to bite them away with strong sharp gnawing forceps. A dry tampon is first applied and left in place for at least five minutes, then the space is tamponed with gauze saturated with compound tincture of iodine and then with gauze saturated with Beck's bismuth paste. In obstinate cases 2 to 10 per cent of nitrate of silver solution may be used on the tampon or 10 per cent solution of argyrol.

It is important to bear in mind the relation between these cells and the meninges because it has repeatedly happened that an inexperienced operator has caused a meningitis by carrying his manipulations too far.

Frequently the infection of the ethmoid cells is due to an infection caused by the presence of nasal polypi. These may produce the infection simply from an extension of this process, or the natural drainage may be interfered with owing to a blocking of the nasal space due to the presence of polypi.

NASAL POLYPI.

Usually patients do not come under the surgeon's care until nasal polypi have attained a sufficient size to cause obstruction.

Under cocaine anesthesia the pedicle of the polypus can usually be grasped with curved polypus forceps passed through the nares under the guidance of the index finger introduced through the mouth. The smaller polypi must be removed by means of a polypus forceps through a nasal speculum with illumination from a head mirror. Freer's instruments seem most convenient for this purpose. This and the previous operation are accompanied by severe hemorrhages which may necessitate performing the operation in several stages, with intervals of several days.

It is possible in most cases to do the operation at one sitting by tamponing the surface with gauze and interrupting the operation temporarily while this is being done, but the effect of this plan is often not borne well by the patient.

POST-NASAL ADENOIDS.

The removal of these structures is usually accomplished at the time of some other operation, like excision of tonsils or of tuberculous lymph nodes of the neck.

The patient is placed in Rose's position upon his back with the head projecting dependently beyond the end of the table and held firmly between the hands of an assistant. Either general or local anesthesia may be employed. The uvula is drawn forward with the index finger of the left hand and the adenoids on the posterior wall are cut away quickly by means of a Gottstein curette.

A small ordinary curette is then introduced, first through one and then through the other nostril, and all of the remaining adenoids are curetted away carefully under guidance of the left index finger. It is important to protect the opening to the Eustachian tube with the end of the index finger.

The entire surface is then very vigorously rubbed with the index finger covered with a few thicknesses of sterile gauze.

The patient's diet and hygiene are carefully controlled after the operation and especial stress is laid upon the practice of breathing exercises.

CONTRACTED NARES.

Nares which have been contracted because of former injuries to the nose should be treated by forcibly loosening the displaced bony structures and then treating the condition as one would a fractured nose primarily.

FRACTURE OF NOSE.

In the treatment of this accident two results must be constantly borne in mind: 1. The patient must be able to breathe through both nostrils after recovery. 2. He must not remain unreasonably deformed.

The first object may be accomplished by applying suitable perforated intranasal splints made of hard rubber, aluminum or silver. The latter purpose is fulfilled by carefully regulating the support to the external surface of the nose throughout the process of healing.

DEFLECTED SEPTUM.

What has just been said applies with equal force to this condition. By grasping the deflected septum with strong forceps and thoroughly fracturing it so that it ceases to take upon itself its former deformity, and then applying the same intranasal splints for a month excellent cosmetic and functional results may be looked for.

SADDLE-NOSE.

If this condition is due to an old fracture this should be reproduced as nearly as possible and then the case should be treated according to the method already described. If it is congenital then it is usually best to correct the deformity by the use of paraffin injections.

Traumatism is the most common cause of saddle-nose, and next in frequency comes syphilis, either acquired or congenital. It may also result from simple abscess of the septum. Any condition causing destruction of the nasal septum, may result in this deformity as that removes the support of the nasal bones and cartilages.

Use of Paraffin.

Several methods of correcting this deformity have been devised, such as inserting plates of celluloid, platinum or silver underneath the skin, as a substitute for the natural bridge of the nose, but none of them is as simple or effective as the subcutaneous injection of paraffin. This method of treatment is very simple and there is no resulting scar from its use. It has a further advantage in that it causes very little reaction of the tissues and does not necessarily confine a patient to the house, thus allowing him to immediately resume his daily pursuits.

Although the treatment is very simple, still there are some dangers connected with the use of the paraffin. The chief dangers are abscess formation and sloughing of the tissues from infection, also sloughing from pressure necrosis from hyper-injection. A few cases of embolism have been reported immediately following injection for deformity of the nose.

Technique.

If the patient is an adult and is not particularly nervous, the paraffin may be injected without the use of a general anesthetic. In such it is well to administer a quarter of a grain of morphine hypodermatically half an hour before the treatment is to be given. The majority of patients prefer to take a general anesthetic, the after-effects of which are very slight, because the patient is anesthetized for only a few moments.

It is very important that absolute asepsis be carried out during the process of injection, for the slightest infection is apt to result in abscess formation and sloughing of the tissues. A special syringe should be used so that the paraffin can be forced out through the needle after it has hardened, and also so the paraffin may be injected very slowly. The syringe should be constructed of metal and fitted with a thumb screw upon a worm on the piston-rod, which can be screwed into the head of the syringe after it has been filled with melted paraffin. A good-sized ring should be firmly attached to the distal end of the piston rod so that the piston rod may be turned easily, which will gradually lower the piston and force the paraffin out through the needle in the shape of a cylindrical

thread. The syringe as devised by Harman Smith has proved very satisfactory to the authors.

The paraffin should be thoroughly sterilized and then is maintained in a liquid state by keeping in a hot water bath until used. The paraffin is now poured into the syringe, and allowed to solidify before injection. The needle on the syringe should be about two inches long and should be inserted from above downwards, that is, toward the tip of the nose, so that the injection will be made toward the tip of nose and not toward the base. In the three cases of embolism of the central artery of the retina immediately following injection of paraffin for correction of nasal deformity, each injection was directed toward the root of the nose instead of toward the tip. The skin over the base of the nose, a considerable distance above the depressed portion, should be grasped between the thumb and finger of the left hand, and the needle introduced through the skin at this point, then the needle is passed downwards along underneath the skin to a point near the lowest part of the depression. An assistant now grasps the nose at its base just above the depression to prevent the paraffin from backing up above the depression. The piston rod of the syringe is now turned slowly and as the paraffin enters the tissue it is gently molded into the proper shape. Care must be used not to inject too much paraffin. When the skin over the area of injection becomes white the injection should be stopped. If the depressed area has not been raised sufficiently, it is better to inject a second or third time than to cause too much tension by injection of a large amount primarily. Care must also be used to have the paraffin lodge in the right place, otherwise the deformity may be increased. After the injection the needle puncture is sealed with collodion and no further dressing applied.

FOREIGN BODIES IN NOSE.

Ordinarily it is possible to remove foreign bodies from the nasal cavity without difficulty by the use of forceps, blunt curettes or wire loops, but if they have been in position long enough to cause edema, necrosis or suppuration it is often difficult to accomplish their removal.

This is also the case if the patient has had foreign bodies forced into the nose during explosions or railway, automobile or runaway accidents.

We have removed nails, stones, and in one case a piece of wood 4x1.5x.5 cm. in diameter from the noses of such patients.

In these cases general anesthesia, followed by a careful exploration is necessary. After removal of the foreign body the space should be carefully tamponed to prevent infection and hemorrhage.

EPISTAXIS.

Following the various operations of the nasal cavity, and sometimes independently, patients suffer from severe hemorrhages from the nose, which may be almost uncontrollable. But we have always succeeded in overcoming the hemorrhage, even in the most desperate cases, by taking a piece of soft gauze twenty-four cm. long and twelve cm. wide, and folding it upon itself so as to make a bundle 12 cm. long and just thick enough to occlude the posterior nares. The width must vary slightly with the size of the patient and the length with the quality of the gauze. Two

pieces of double silk are tied about this gauze so as to divide it into three equal portions. A small soft-rubber catheter is now passed through each nostril and guided out through the mouth, then one piece of the silk is tied to each catheter and pulled forward through each nostril, the gauze being guided into place with the index finger. The two strands of the double silk strung are then separated and a pledget of cotton sufficiently large to close the nostril is tied into this string on each side the gauze, being carefully adjusted in the posterior nares in the meantime so as to occlude these completely.

The nostrils will become filled with blood and this will form a plug which will supply the necessary pressure to control the hemorrhage. The strings should be tied over the anterior plugs in such a manner that they can be readily untied in two or three days for the removal of the plugs. If the bleeding vessels have not been occluded hemorrhage will recur at once or after a short time, and then the anterior plugs will have to be renewed.

CHRONIC RECURRENT EPISTAXIS.

This condition is usually due to anemia and should be treated with internal remedies, diet and hygiene. In other cases it is due to an erosion of some vessel in the mucous lining of the nose. In such event the bleeding surface should be touched with the electric cautery under local anesthesia.

FRACTURES OF THE LOWER JAW.

In the treatment of fractures of the lower jaw the fragments may be held in position by making use of the upper jaw as a splint, by forming a splint of strong wire covered with fine rubber tubing and applying it along the alveolar process, either to the inside or outside of the teeth, or upon both sides, and holding the fragments in place by winding wire about the splint and the teeth. A grooved metal or hard-rubber splint may be employed to envelope the teeth. Gold rims may be placed on a number of teeth and these may be held in position by means of screws. A horseshoe-shaped splint may be fitted externally to the lower jaw and held in place by means of bandages, or it may be adjusted mechanically like the ingenious splint introduced by Matas.

Two conditions must be borne in mind which are peculiar to fractures of this bone: First, the proximity to the cavity of the mouth which always contains pathogenic micro-organisms; second, the fact that the fracture must be so dressed that feeding of the patient is possible. The mouth should be frequently irrigated with normal salt or with boric acid solution, and provision should be made for passing a tube into the pharynx through which the patient may receive liquid nourishment at regular intervals. Usually there is a space between the teeth but if this does not exist a tube can be carried around the teeth into the pharynx.

In a large proportion of these cases there is a communication between the fracture and the mouth cavity. Fortunately for the patient infection of these compound fractures seems less harmful than in other bones.

TUMORS OF THE JAW.

The most common tumor of the jaw affects the alveolar process. It begins as a hard, fibrous mass near the root of a tooth and progresses into

the substance of the jaw, the tooth becoming loosened, and may develop a growth of considerable size. Presently it advances along the mucous membrane of the mouth and later it may extend into any of the surrounding tissues. During the early part of its development this tumor is composed of only fairly developed connective tissue cells. As it advances these become more and more embryonic until the growth has the appearance microscopically of a spindle-celled sarcoma. If it is partly removed its growth seems to be greatly stimulated, and if removed incompletely several times it will progress in the usual course pursued by a sarcoma.

Technique.

To make room one or two teeth should be extracted beyond each end of the growth, the entire alveolus should then be chiseled away deeply and the soft tissues covering the jaw should be removed together with the bone. Then the entire area should be thoroughly cauterized either with a Paquelin cautery or with a cautery-iron of considerable size which has been heated to white heat in a flame. The thorough destruction of the deep tissues by means of the cautery seems to be the important part of this operation. If this is done reasonably early these growths practically never recur.

In many of these cases that have come early we have been able to cut away the growth, together with the underlying periosteum, with a sharp chisel and then at once produce a deep scar with the actual cautery without being compelled to remove even a single tooth. This should always be done under general anesthesia because otherwise one is likely to cauterize too superficially. In the presence of doubt one should, however, never hesitate to remove one, or several, or even all of the teeth. Thoroughness means success in this operation.

DENTIGEROUS CYSTS OF THE JAW

The retention of the embryonic teeth within the jaw gives rise to the formation of a bone cyst. It is frequently difficult to differentiate this from sarcoma except through the history, although the cyst wall usually yields under pressure with the finger placed upon the inner side of the jaw, giving rise to a crackling sensation. The patient is frequently aware of the presence of a swelling for months or years before the physician is consulted. Were he suffering from a sarcoma there would be secondary involvement long before this time. During the early part of the development of a cyst of the jaw, however, it is not possible to make a positive diagnosis. There is always an unerupted tooth as the cause of this affection, but so few patients keep an accurate record regarding the number of teeth they have had extracted that one cannot make any reliable calculations from the number of teeth that are left.

Technique.

The jaw should be chiseled open either from below, an incision being made through the skin and periosteum and the latter reflected, or from the mouth, one or two teeth being extracted to make room for the operation. The cavity is carefully chiseled out, tamponed, and permitted to heal by granulation. Usually some remnant of the embryonic tooth is found. The progress is good.

Frequently these cases come under the care of the surgeon after they have been operated, showing only a sinus leading down to the denuded

bone, which we have often discovered to represent the lining of the infected cyst, but more frequently we have found a portion of a tooth or a partly-developed tooth at the bottom of the sinus.

SARCOMA OF THE LOWER JAW.

The only treatment that promises relief in sarcoma of the lower jaw is the excision of the entire half of the maxilla involved. This is accomplished by making an incision along the lower border of the jaw from the angle thereof to a point beyond the middle line of the chin. The soft tissues are carefully separated, the mouth opened, a tooth is extracted opposite the point at which the jaw is to be separated, and then a chain saw or a wire saw is carried around the bone, and while the wound in the skin is retracted in order to prevent its injury, the bone is sawed off. The end of the jaw is then grasped in a pair of lion-jawed forceps and carried out through the wound in the skin. If the tumor is located near the angle of the jaw it is best to remove the entire half of the maxilla, making an ex-articulation. This is accomplished by successively loosening the soft tissues, grasping the bleeding vessels that are encountered, and forcing the jaw outward, dislocating the joint and then cutting away the capsule. The only point at which one encounters any difficulty is the attachment of the styloid process, but with a little care and manipulation this can be loosened readily.

It is wise to grasp the facial artery and vein at the point at which they cross the lower jaw before cutting these vessels, because in this way the wound may be kept practically free from blood. A drain is inserted in the posterior and anterior angles of the wound. The mucous membrane is first sutured and then the skin is sutured up to the point of drainage.

In case any of the surrounding tissues have become involved these should be removed freely, but it is doubtful whether much benefit can come in these cases from an operation if the disease has advanced to the point of invasion of surrounding tissues.

CARCINOMA OF THE LOWER JAW.

Carcinoma of the epithelial structures of the mouth frequently invade the lower jaw. Usually cases which have advanced to this stage are practically hopeless, still it is proper to attempt the cure of some by employing the treatment which has just been described in connection with sarcoma of the lower jaw.

ALVEOLAR ABSCESS.

This affection is so simple that it seems scarcely necessary to describe its treatment, which should consist in thorough disinfection of the cavity of the mouth, free incision of the abscess, thorough irrigation of the mouth after incision at intervals of one hour at first and less frequently later. Should the incision show a tendency to close a folded piece of rubber tissue may be inserted to keep the wound open, and thus facilitate drainage and healing from the bottom.

OSTEOMYELITIS OF THE LOWER JAW.

Following severe infectious diseases, or severe infection from the root of a tooth, there is frequently a destruction of a portion or the entire lower jaw, due to osteomyelitis. Occasionally this disease also follows a com-

pound fracture of the lower jaw. It is accompanied by severe pain, much edema, a high temperature and frequently by severe chills.

Technique in Acute Cases.

When seen in the acute stage a free incision should be made through all the tissues, including the periosteum down to the bone. This will relieve the tension and produce drainage by directing the lymph stream away from the infected area. This will reduce the necrosis of bone tissue to a minimum. In many instances almost no sequestration will follow, as the bone seems to have the power of regenerating without destruction, while in cases in which the periosteum has not been incised large portions of the bone will be exfoliated in the form of sequestra.

In later cases in which the jaw bone has already been destroyed by the infection it is a grave error to remove the dead bone at once. In these the periosteum should also be laid open and the dead maxilla should be left in place to act as an irritant to the formation of an involucrum, and also to take the place of a mold over which the involucrum can be formed without necessary and unsightly deformity.

This treatment will be followed by the formation of a nearly perfect maxilla, while neglecting to incise the periosteum, or removing the dead bone at once, will be equally certain to produce results which are cosmetically and functionally bad in proportion to the extent of the disease.

Technique in Chronic Cases.

In old, neglected cases and in those which were not treated surgically at all during the acute stage, or treated too late, or in which the periosteum had been properly incised during the acute stage and in which an involucrum has properly formed, the sequestrum causes continuous discharge of pus through one or more fistulæ. In all these the sequestrum should be exposed.

It is usually necessary to cut away some of the involucrum here or there in order to remove all of the necrosed bone. This should be done carefully in order not to fracture the involucrum. The space should be temporarily tamponed with gauze for two or three weeks; the skin should be carefully sutured in order to reduce the deformity to a minimum. After the gauze has been removed it is well to fill the space it occupied with Beck's bismuth paste, consisting of one part of subnitrate of bismuth and two parts of yellow vaselin. It is important not to inject this with much force, and the injection should be repeated once or twice a week until the cavity is closed.

PHOSPHORUS POISONING.

In persons working in badly-ventilated factories wherein phosphorus is employed in various manufactories, a necrosis of the jaw frequently occurs.

The treatment must consist in at once permanently changing the patient's employment, directing his diet and his general hygiene and in treating the local condition the same as acute osteomyelitis.

ANKYLOSIS OF JAW.

In complete ankylosis of the lower jaw the same operation is indicated as in ankylosis of other joints, which is described in another chapter.

In partial ankylosis the jaw should be mobilized under ether anesthesia and cork posts should be placed between the teeth on either side, with the mouth opened to the greatest possible degree in any given case. The patient should be kept fairly free from pain by the hypodermic use of morphine for at least a week while the mouth is being held open in this manner. Then the posts may be removed and somewhat smaller ones put in their place and worn regularly during the night, while during the daytime the patient may exercise the jaw. It may be necessary to repeat the mobilization under anesthesia several times at intervals of several weeks.

The treatment should be continued for a number of months.

The mouth should be kept covered with several layers of gauze while it is being held open by the posts in order to prevent harm from inspiration of dust or cold air.

Even after the patient has apparently completely recovered it is well to wear the posts between the teeth at least for one night each month to prevent recurrence.

EXCISION OF THE UPPER JAW.

The method introduced by Kocher seems most satisfactory. We have practiced it in many cases. It can be done most easily by first ligating the common carotid artery, temporarily, or by ligating the external carotid artery, either temporarily or permanently. If the temporary ligation is employed this is removed after the operation upon the jaw has been completed, the space carefully tamponed with gauze, and the patient placed in the sitting posture.

If the operation is performed without preliminary ligation the patient should have his head elevated throughout the operation by using the exaggerated inverted Trendelenburg position. A few times we have performed the operation rapidly in elderly persons, in whom preliminary ligation seemed contra-indicated because of the presence of marked arteriosclerosis, with the patient in Rose's position with the head dependent beyond the end of the table, but the plan of operating with the head elevated seems much more satisfactory.

Technique.

An incision is made in a vertical direction through the middle of the upper lip, it then follows the base of the nose up to the edge of the orbit, then outwards to the junction of the malar and fourth bones. The entire flap is reflected outwards and then the jaw is cut away with heavy bone-cutting forceps. The bleeding is controlled by pressure with gauze pads.

This operation is indicated only for the removal of malignant growths, hence it is wise to apply large cautery irons heated to red-heat to all of the raw surfaces. This will destroy any remaining portions of diseased tissue and will definitely stop hemorrhage. The space is then carefully tamponed, preferably with formidine gauze, and the skin flap is carefully sutured in place throughout.

If indicated by the condition of the malignant growth the malar bone may be removed in part or entirely. If its orbital plate is removed it is well to remove the eye also.

The cosmetic result following this operation is relatively very satisfactory.

EXCISION OF THE PAROTID GLAND.

The removal of a portion of this gland is most frequently indicated in connection with the removal of tuberculous lymph glands of the neck. Its total removal is most commonly required for enchondroma. It is important in these cases to make a perfectly clean dissection, because if any portion of the tumor remains it is likely to recur in the form of sarcoma which can only rarely be permanently cured by a secondary operation. On the other hand, if the entire gland, together with its capsule, has been enucleated fairly early at the primary operation a permanent cure may be expected. The dangers of the operation are unimportant and will be discussed in connection with the operation for the removal of tuberculous glands of the neck.

EXCISION OF THE TONGUE.

Carcinoma.

Carcinoma of the tongue is not very uncommon and fortunately it is frequently amenable to surgical treatment, the prognosis being favorable in quite a considerable proportion of cases. If the portion involved is confined to the anterior half of the tongue its removal is quite simple. The tongue is drawn out of the mouth, is transfixed at its base with a needle armed with a strong double silk suture; the tongue is tied in halves, considerable force being used in order to prevent the possibility of hemorrhage during the operation. A second strong silk suture is passed through the tongue just above the insertion of the first; with this the tongue is drawn forward. Then the diseased portion is cut away, leaving just enough beyond the silk ligature to permit the suturing of the two halves of the tongue in the median line. Upon inspecting this surface the blood vessels on the lower surface near the median line can readily be discovered. These are caught in hemostatic forceps and ligated separately. A row of sutures is then applied, bringing the two halves of the cut edge of the tongue in accurate apposition. These sutures are carefully tied and then the silk sutures are cut. The second silk suture which was applied is left in place for twenty-four or forty-eight hours in order to prevent the tongue from falling back into the pharynx. This accident happens very rarely, but when it does occur it is very troublesome unless some provision is made for holding it forward.

Glandular Invasion.

The submaxillary lymphatic glands and the cervical glands in front of the deep jugular vein are most likely to be involved secondarily in this condition, and if the disease is at all advanced it is wise to make an incision on each side and remove these glands, even though it may not be possible to palpate them through the skin. If the disease extends to the posterior portion of the tongue, either on one or both sides, it is best to make a temporary ligation of the external carotid artery before beginning the operation. This may be accomplished most readily by laying bare the artery at its origin on each side and applying a pair of clamps which have been especially constructed for this purpose. These clamps should not be sufficiently strong to cause any injury to the vessel, but just strong enough to prevent the passage of blood through it. The jaws of the instrument should be covered with drainage tubing to prevent the crushing of the vessel walls. The operation is thus rendered practically bloodless and can be accomplished

with great thoroughness. The larger vessels should be caught in hemostatic forceps and ligated separately and then the stump which is left should be carefully closed by means of a sufficient number of sutures to prevent oozing. After the entire surface has been carefully covered the forceps are loosened first on one side and then on the other. In case hemorrhage occurs they can be compressed again and the bleeding controlled by the further application of sutures.

With this location of the growth there is still greater likelihood of invasion of the cervical and the submaxillary lymphatic glands, and in such instances their removal is always indicated, although it may not be possible to palpate them through the skin. In case the floor of the mouth is involved together with the tongue, the same preliminary compression of the external carotid should be made, but in order to make a complete removal of the tissues it is wise to split the lip and the lower jaw through the middle down to a point just above the thyroid cartilage, to insert retractors in each segment of the jaw, and to open the entire space by careful continuous dissection. In this way the entire floor of the mouth and the base of the tongue may be perfectly exposed. The larger blood vessels are caught and ligated successively.

The excision of the tongue is performed as described above and if there is any mucous membrane left after the entire growth has been freely excised this is utilized for the purpose of lining the floor of the mouth. After this operation the forceps upon the arteries should be loosened before the jaws are united in order that all of the hemorrhage may be carefully controlled. After this has been accomplished the two halves of the jaws are united by means of chromicized catgut sutures. The floor of the mouth is drained through the lower end of the incision and the remaining portion of the wound is carefully closed.

This method provides a very perfect exposure of the field of operation, but it is, of course, very much more severe than the operations which have just been described, and we believe that it is indicated only in cases in which there is involvement of the floor of the mouth.

RANULA.

In operating for the relief of ranula the object to be attained is either to establish a new communication between some portion of the ducts of the sublingual glands involved and the cavity of the mouth, or the complete removal of the entire gland. The simplest method by which to re-establish a connection between the ducts of the gland and the cavity of the mouth is through the use of a seton. By applying a large-sized silk suture transversely across the ranula and tying this loosely so that it does not have a tendency to cut away the intervening portion of the mucous membrane, one may frequently secure the growth of epithelial cells in these openings through which the silk sutures passes so that the lining of the duct and the cavity of the mouth become continuous. After this has occurred at both the point of entrance and exit of the suture a new suture may be introduced through the same openings and tied more tightly so that the intervening tissue may become absorbed slowly. The opening formed between the cavity of the ranula and the mouth will thus become continuously lined with mucous membrane and presently a permanent opening will be established. This, however, will not occur in every case and it may become necessary,



PLATE III

EXCISION OF TONGUE

This plate shows the base of the tongue compressed by two strong silk ligatures which have been applied by passing a needle armed with a double ligature through the center of the tongue and tying in halves. These ligatures are removed after the diseased portion of the tongue has been cut and the vessels at (aa) have been separately ligated and the sutures (bb) and (cc) have been inserted.

When the temporary ligatures are cut traction is made upon the suture (bb), which will bring the lateral flaps into apposition. Then the sutures (cc) are tied and then (bb) and the mucous membrane is closed by a continuous cut and gut suture.

later, to remove a considerable portion of the tissue between the cavity of the mouth and the ranula, to sponge this cavity dry, and to cauterize it either with the actual cautery or with strong carbolic acid, followed after a few minutes with strong alcohol, or by the use of some other caustic, and then by the application of a tampon of iodoform gauze to the cavity thus formed. In a number of cases none of these methods will succeed and then it may become necessary to dissect out the entire gland in order to prevent recurrence. Unless the ranula has been severely inflamed it is usually possible to find a line of cleavage and to peel out the mass in a manner very similar to the method described in the removal of a branchial cyst. It is necessary to drain this cavity because its communication with the cavity of the mouth is likely to prevent preliminary healing.

SUBLINGUAL CYSTS.

Occasionally a dermoid cyst is found in the region of the hyoid bone which may be mistaken for a ranula. It may sometimes be differentiated from a ranula by the presence within the cavity of some epidermal structures, such as hair or teeth. The diagnosis is usually not made until these structures are encountered because of the much greater frequency of the presence of an ordinary ranula.

It is, of course, very evident that nothing but the complete excision of this growth will accomplish anything. There is usually a line of cleavage which can be followed and the growth peeled out with little difficulty, unless there has been a chronic inflammation causing extensive adhesions. It is necessary to take especial care in dissecting out this growth at the point of its attachment to the hyoid bone because it is at this point that one is likely to leave a small portion which will give rise to a recurrence.

EXCISION OF TONSILS.

Complications.

In this climate a large proportion of children and young adults suffer from the presence of hypertrophied tonsils, very commonly complicated by the presence also of adenoids in the post-nasal space. This condition is exceedingly harmful, because it prevents the patient from normally performing the functions of respiration. The amount of air permitted to enter the lungs with each inspiration is greatly reduced unless the mouth be kept open, and in that case the patient suffers from the inhalation of impurities otherwise removed from the air by its passage through the nostrils, and by inhaling air which has not been modified either in temperature or moisture.

In many children there is a marked contraction of the chest due to this condition, and although the obstruction may later be removed the lung capacity can scarcely be fully attained because of the deformity which already exists.

Avenues of Infection.

The tonsils and post-nasal adenoids are also very likely to become infected with various pathogenic micro-organisms, the most common acute forms being those from ordinary pus microbes, the diphtheria bacilli, the micro-organisms of influenza and the pneumonia diplococcus, while a large proportion of these patients suffer from infection with tubercle bacilli. In this way the patient constantly carries about a dangerous septic focus. In

many of these cases the infection from the tonsils and adenoids extends into the Eustachian tubes and gives rise to deafness, or it advances into the middle ear through the Eustachian tube, producing suppurative inflammation of this cavity, which may further result in an infection of the mastoid cells. It is not uncommon, moreover, for the infection to become acutely intensified, resulting in tonsillar abscess or an infection of the deep tissues of the neck.

There is scarcely another circumscribed area in the body from which so many secondary infections proceed as from the tonsil. It is one of the most common sources of cryptogenetic infection, and frequently responsible for acute osteomyelitis. So long as this organ is normal there can be no doubt but that its lymphatic structure enables it to destroy a great number of pathogenic micro-organisms, but after it has once become diseased and filled with these micro-organisms their presence is a menace to the health of the entire body.

Technique.

The indication for treatment is unquestionably plain in every case in which any of the circumstances that have been mentioned exist. The portion of the tonsil which causes the obstruction, and which contains the septic material, should be removed. This may be done very easily and safely by means of any one of a number of instruments which have been especially constructed for this purpose, or it can be done by grasping the tonsil with a pair of volsellum forceps and cutting away as much as desired by means of a sharp scalpel or by a pair of sharp, long-handled scissors. It is wise to anesthetize the mucous membrane by spraying the surface with a four per cent solution of cocaine, in order to make the operation less painful. If a tonsillotome is used, it should be applied from below upward and from behind forward.

Methods of Hemostasis.

Unless the tonsil is acutely inflamed, in which case the operation should be postponed, there is but slight danger from hemorrhage. If the organ is drawn too tightly into the cavity of the pharynx before it is cut off the tonsillar artery sometimes bleeds considerably. For the purpose of controlling this hemorrhage we have found the following mixture most useful; A teaspoonful of acetanilid, a tablespoonful of alcohol and about two ounces of water are mixed and used as a gargle. This usually stops the bleeding almost instantly. If this does not suffice pressure made with a sponge held at the end of a pair of forceps for a period of five minutes will usually be efficient. Should this also fail it is well to insert a cat-gut stitch about the base of the tonsil and to tie just firmly enough to stop the hemorrhage. There is an instrument constructed with two padded branches, one of which is inserted into the mouth and placed directly upon the bleeding tonsil, and the other at a point opposite on the outside of the neck. When this instrument is closed it makes a sufficient amount of pressure on the tonsil to stop the bleeding. In over two thousand tonsillotomies that we have personally made, we have never been compelled to use any of these methods except the gargle with acetanilid, alcohol and water, although in one instance we had quite a severe fright from a patient who was a hemophiliac and belonged to a hemophilitic family, a fact which had escaped our observation.

For the after-treatment the patient should be given some mild antiseptic gargle, which should be used mornings and evenings for a number of

months following the operation, in order to improve the state of the mucous membrane of the pharynx.

The Post-nasal Adenoids.

In these cases it is usually wise at the same time to curette away the post-nasal adenoids by means of a flat curette with the cutting edge at right angles to the handle and directed away from the handle. The instrument known in the market as the Gottstein curette is most useful for this purpose. The first finger of the left hand should be inserted above the uvula, and with the right hand the adenoids should be curetted away with a few quick motions. If the patient is anesthetized for this purpose he should be placed in the inverted position with the head dependent from the end of the table. After this has been done an ordinary small, semi-sharp curette should be introduced through the nostril, and with the finger still above the uvula to guide the spoon, the slight remnants of the adenoids which have not been removed with the flat curette may be carefully scraped away. Then a piece of dry gauze, doubled upon itself about four times, is introduced on the end of the finger, and with this the entire space is thoroughly rubbed, so as to remove any small portions that may still be present.

Breathing Exercises.

It is important that all patients who have suffered from the presence of hypertrophied tonsils and adenoids should be given careful instruction in breathing exercises. They should be taught to inhale fully through the nose, with the lips closed, so as to expand the chest to its fullest extent, being sure to make use of the diaphragm in this exercise. They should then force out the air—resisting with the lips—or, better still, they should blow through a small tube, with an opening about two millimeters in diameter, until the lungs have been emptied as much as possible. This exercise should be repeated about twenty times every morning and evening. It is remarkable how greatly these patients are benefited by this simple exercise.

Methods of Holding the Patient.

Concerning the operation of tonsillotomy, we wish to emphasize the fact that it is greatly facilitated by having the patient's head held perfectly firm between the hands and against the chest of an assistant, if the patient is not under the influence of an anesthetic. It is wise in this case to have the patient drop his arms to his sides and then wind an ordinary bed sheet around his shoulders several times, so that he cannot interfere in the operation. An adult not under the influence of an anesthetic should be seated in a firm chair, an assistant should stand behind him, place one hand on each side of his head and force the same backward against his chest, so that the latter is held firmly on three sides. Children are best held by seating them in the lap of an assistant, who takes their limbs between his knees and holds the child in the manner described for performing intubation.

In using the tenaculum forceps and scissors, or scalpel, it is necessary to apply a gag between the teeth of the patient. This is also necessary in the use of some tonsillotomes, while with others it is possible to operate without because the tonsillotome itself prevents the teeth from closing.

Limits of Excision.

Much discussion has developed of late as to the extent to which it is

proper to remove tonsils. For a time it appeared as though only the complete removal of the gland could be looked upon as a proper operation, but at the present time even those who are engaged in the special field of throat surgery seem to show signs of conversion to the belief that the best operation is that which removes only the diseased portion of the tonsil and leaves the remainder for the future protection of the patient.

TUMORS OF THE LIP.

Angioma.

Angioma is the most common of all tumors in the lips of children. The growth appears as a little purple mark usually not larger than the head of a pin. This will increase in size in time until it may involve the entire lip. Later, it may extend over the face so that quite a portion thereof may be involved. After attaining some development this growth is likely to vary in size with differences in the temperature of the air in which the patient exists. While out of doors in the cold it will decrease so that it can scarcely be noticed, but when the patient is in a warm room it may increase so as to be quite troublesome.

Angioma of the skin in this vicinity, as in every other vicinity, should be removed at once as soon as the diagnosis is made, because its removal is a very simple matter in the early part of its development, while later on it may involve the reduction of a considerable deformity. So long as the growth is very small, not larger, for instance, than one or two millimeters in diameter, a simple puncture with a needle heated to white heat or with the fine knife of the electro-cautery or the fine point of a Paquelin cautery, will suffice to destroy an angioma permanently. If the growth has developed to a larger size it is best to excise it and to suture the wound so that the scar will be in the least offensive position.

Wyeth Method of Treatment.

Recently Wyeth has introduced a new treatment which is especially valuable in cases of nevus in which the tumor has advanced so far in its development that its removal would result in a marked deformity, or in which the operation would have to be so extensive as to endanger the patient's life. In these cases a large metal syringe is filled with boiling water, which is injected directly into the angioma through a hypodermic needle about the size of an ordinary darning needle. As soon as the surface of the tumor begins to look white the injection is stopped. We have never injected more than four ounces at one sitting, but in case the tumor is large we think the amount might be exceeded with safety. Where the tumor is large we have found it necessary to anesthetize the patient.

The injected area becomes hard and somewhat swollen directly after the injection, but within a week absorption begins, which continues for several weeks. The procedure may have to be repeated several times. It is best to wait until the irritation has entirely subsided after one operation, before it is repeated.

Several times when patients have come from a distance we have sent them home with directions to return after several months for further treatment. In some of these cases the cure was complete when they returned, making further treatment unnecessary. This experience has caused us to lengthen the interval between treatments. The method has great value in a class of cases in which excision could accomplish little or nothing.

Epithelioma.

Epithelioma of the lip occurs most commonly in the lower lip in the male. Its removal is indicated at the time when it is first noticed. The removal should always be extensive, at least half an inch of perfectly healthy tissue being excised in every direction. The incision should be at right angles to the edge of the lip and there should be a transverse incision joining the two verticals. All of these incisions should extend entirely through the lip. The transverse cut should extend beyond the vertical to about one-fourth the distance between the two vertical incisions, so that there is a flap on each side which can be brought to meet its fellow and then the transverse incision can be sutured to the lower edge of these flaps. A very considerable amount of the lip may be removed in this manner without leaving any deformity to speak of. If the entire lower lip is to be removed the defect should be closed by means of a plastic operation.

In epithelioma of the lip the submaxillary lymphatic glands and the cervical glands lying anteriorly to the sterno-cleido-mastoid muscle and externally to the deep jugular vein are the ones which are most likely to be involved. If the epithelioma is at all advanced these glands should always be exposed and removed.

Of late we have subjected all of these patients to prophylactic X-ray treatment after the operation. Whether this will prove a proper course to pursue must be determined by further experience.

With a thorough operation performed reasonably early the prognosis is very good.

EPITHELIOMA OF THE FACE.

What has been said regarding epithelioma of the lip applies to epithelioma of any portion of the face. The excision should be done as early as possible. It should be very liberal and the defect caused should be covered by means of a plastic operation so that the resulting scars will interfere as little as possible with the appearance of the patient. Especial care should be taken to avoid tension upon the eyelids because this will result in an irritation of the conjunctiva, which may lead to serious trouble. By transversely suturing wounds in the vicinity of the eyelids tension upon the lids may usually be avoided.

During the past seven years we have subjected a number of these patients suffering from epithelioma to X-ray treatment before subjecting them to operation, and have found that perfect recovery, without operation, as the result of the X-ray treatment is not at all uncommon, provided the epithelioma is superficial. In any case in which an epithelioma can be removed without causing great deformity, and especially without interference with the eyelids. We never use the X-ray at the present time until after the wide removal of the growth.

PART III.

SURGERY OF THE NECK.

Lines of Incision.

It is important to bear in mind the natural lines on the surface of the neck in planning all surgical operations in this region owing to the fact that unsightly scars on the neck are a source of distress to the patient and annoyance to the surgeon.

Incisions in the direction of the sterno-cleido-mastoid muscle are usually less evident from scars than those extending at an angle with this structure, or across it. This is true especially if the incision follows either the anterior or the posterior border of the muscle.

Incisions extending across the neck should be uniform on both sides of the neck if possible.

TRAUMATISM OF THE NECK.

The most common serious traumatism is cutthroat inflicted by the patient himself during an attempt at suicide, or by some enemy.

In all of these cases careful hemostasis and adequate drainage are elements which must be provided for in order to obtain reasonably good results.

Until hemostatic forceps and ligatures can be applied the bleeding may be controlled by placing the ends of the fingers upon the bleeding vessels. Only rarely will it be possible to repair the wound in the side of a vessel. In case one deep jugular vein is entirely severed the patient will usually die from loss of blood before the surgeon arrives, but if it should ever happen that the surgeon appeared in time to find a patient still alive, with one deep jugular vein entirely cut and the other one nicked, an attempt to repair the injury in the second vessel would be proper.

When the pneumogastric nerve has been severed the patient is at once in a hopeless condition from hemorrhage from the deep jugular vein and the carotid artery before help can be obtained, consequently this condition need not be discussed at this point.

INJURY TO THE TRACHEA.

When the trachea has been cut the patient usually coughs and struggles so violently, because of the fact that he fills his trachea with blood with every inspiration, that it is difficult to control the hemorrhage. It is, therefore, best to place the patient in the prone position, and if this is not possible, in the sitting posture, to make digital compression of the bleeding vessels and then to control the hemorrhage with hemostatic forceps. The trachea should

then be carefully sutured with fine chromic catgut, then the vessels should be ligated.

An abundance of tubular and gauze drainage should be inserted, the cut muscles and fascia and the overlying skin should be sutured and a dressing applied.

It is seldom possible to unite the cut trachea so accurately that no infection takes place into the wound. If the wound in the trachea is irregular it may not be possible to close it. In that case an intubation tube should be inserted, the wound about this should be tamponed with gauze and the remainder of the operation carried out as described before.

CRUSHING INJURIES OF THE NECK.

Crushing injuries may be so severe as to cause fractures of the larynx or the cartilages of the trachea.

In the event of dyspnea due to the collapse of these structures, or to the edema following the injury, this must be overcome either by the introduction of an intubation tube, which will at once provide a passage for the air and a splint for the support of the injured structures, or if the injured part cannot be reached in this manner, tracheotomy and the introduction of a tracheotomy tube should be employed.

The tube should be removed daily after the third day, to determine experimentally, whether the tissues have recovered sufficiently to make it safe to discard the artificial aid. The patient must, however, be carefully and constantly watched for at least 24 hours after it seems safe to remove the tube permanently.

Many of these patients do much better if kept in a sitting posture. If tracheotomy is performed the canula should be kept covered with two to four thicknesses of moist gauze.

CYSTS OF THE NECK.

Sebaceous cysts occur here as in all other portions of the body and must be treated by total excision, the same care being taken to prevent leaving any part of the lining membrane here as elsewhere.

Dermoid cysts occur in the same way as elsewhere, the many important changes that take place during fetal life in this region making their occurrence somewhat frequent, although these fetal remnants or inclusions in this region usually take the form of branchial cysts or thyroglossal cysts.

The treatment consists in careful, complete excision.

Aside from these cysts we encounter lymphangiomata, bursæ, hydrocele, blood cysts (aside from cysts of the thyroid gland) and hydatid cysts.

BRANCHIAL CYSTS.

During the early development of the embryo there are four clefts on each side of the neck corresponding to the gills in fishes. These latter become obliterated, but occasionally the layers do not unite perfectly and there are left portions of the epiblastic tissue which have not been destroyed and which later secrete a fatty substance which will accumulate in this defect and presently form what is known as a branchial cyst.

The cyst develops slowly, is located underneath the skin and superficial fascia, fluctuates upon palpation, and is not inflammatory in character.

The incision is advisably made over the cyst in the direction of some of the longer lines of the neck, and upon approaching the growth a point will be reached where there is a longer line of cleavage between the tissues. By separating the cyst from the surrounding tissues through this latter it can be easily removed. The wound is closed in the customary manner and it heals kindly. By finding the natural line of cleavage one can remove the growth without any danger of injuring the deep jugular vein, in whose proximity it exists, and even if there has been an inflammatory condition which has resulted in adhesions to the deep jugular vein the growth may readily be removed by careful dissection without danger.

What has just been said may be applied to all of the other cysts mentioned, with the exception of those of the thyroid gland, which will be considered later, and the hydatid cyst which is due to a parasite and which may occur between the layers of any of the structures of the neck. This latter form will be recognized by the fact that within a capsule of connective tissue there is a second cyst which is no part of the human body, but of the parasite. This will peel out spontaneously as soon as the connective tissue covering is open, for there is no connection between the two structures.

GOITRE.

Until recently it has generally been supposed that in this country patients suffering from goitre rarely afford a characteristic history such as they give in portions of Switzerland, France or Wales, where certain regions seem to furnish a very large proportion of patients, while other regions are relatively free from them.

Apparent Cause.

Since goitre has been studied more carefully in this country many regions have been found where this disease abounds and recently a number of farms have been investigated each supplied by a single well which has seemed to cause the appearance of goitre, especially in the younger members of the family, from drinking the water. Families having been quite free from this disease have taken up their homes upon these farms, and within a year several members thereof have become afflicted, then changing their residence the children who were born later remained free from the disease.

One of the instances quoted frequently shows the influence of this infected water so clearly that it seems wise to repeat it here.

Example.

Two private schools located only a few miles from each other obtained their drinking water from two different springs. Both schools obtained their pupils from many distant points. The pupils of one of these schools developed goitre regularly while the pupils of the other school as regularly remained free from goitre. When the water supply of the first school was changed the pupils also remained free from goitre while attending this institution. Kocher claims that if water is boiled it loses its infectious character and becomes quite as harmless as that from any pure source. Whether this is due to the precipitation of lime salts contained in the water, or to some microorganisms, has not yet been determined.

It seems, however, imperative that families in which several goitres have occurred be advised to use water for drinking purposes from an entirely different source of supply, or else that they invariably boil all drinking water

from the well which is supposed to have caused the goitres already developed.

Characteristics.

The enlargement of the thyroid gland more commonly appears about the age of puberty than at any other time. It also occurs during gestation in quite a number of patients. It happens much more frequently in this country in females than in males. It may affect any one or two, or all of the lobes of the thyroid gland. When the middle lobe is involved there is frequently an enlargement extending down behind the upper end of the sternum, causing quite severe pressure upon the anterior surface of the trachea. The patient may seek relief because of the deformity caused by the presence of the tumor; because of its weight on the neck; or because of the obstruction in the trachea produced by pressure from a lobe of this gland. The enlargement may be due to an increase in the parenchyma of the gland, or one of the lobules may be distended with gelatinous or serous fluid giving rise to the formation of a cyst, or there may be a fibrous degeneration of a portion of the gland or the development of a fibrous tumor, or, especially in patients advanced in age, there may develop a malignant growth, either carcinoma, sarcoma, endothelioma or angioma. The enlargement may also be due to a simple infection, with its skin edema.

The diagnosis of a tumor of the thyroid is simple because of the form and location of this gland; also from the fact that if the patient swallows the gland rises with the larynx, being firmly attached to the trachea. An enlargement due to an inflammatory condition can be easily recognized because of the symptoms accompanying inflammatory conditions in any part of the body. Malignant growths are characterized by an induration of the tissues, which is not present in a benign growth of the thyroid gland. The age, and, usually, a rapid development of cachexia, are important conditions to be considered in making this differential diagnosis.

Hygiene and Internal Medication.

In young girls the glandular enlargement commonly subsides if general hygienic measures are employed. This may be somewhat facilitated by administering, three times a day, tablets containing five grains each of the desiccated thyroid gland of sheep, the doses being somewhat varied according to the condition of the patient. General tonics are indicated in these cases. In older patients the absorption of these growths is sometimes further facilitated by the hypodermic injection of from sixty to one hundred and twenty drops of a five per cent. solution of carbolic acid in water, directly into the enlarged lobe. This should be done once each week at first and less frequently later on. The same hygienic and tonic measures should be employed as in younger patients.

In those instances wherein the goitre continues to increase in size notwithstanding the hygienic, dietetic, medicinal and injection treatment just named surgical removal of the gland may be indicated, provided the patient suffers because of the incident pressure, from pain, dyspnea, interference with the recurrent laryngeal nerve or in case the weight of the part becomes burdensome or the deformity repulsive.

EXOPHTHALMIC GOITRE.

From the standpoint of the surgeon the diagnosis of exophthalmic

goitre, in cases coming properly under surgical treatment, is not a difficult matter because no case properly belongs in this class unless treatment with rest, hygiene, diet and internal medication has either failed altogether or has failed to relieve the patient permanently of the disease.

As early as 1786 Parry gave a clear description of the symptoms of this disease. This was repeated by Graves in 1835 and five years later with great clearness by Von Basedow, and since then innumerable times by hundreds of clinicians.

The following may serve as a short, concise summary of the symptomatology.

Summary of Characteristic Symptoms.

1. Exophthalmos. 2. Tachycardia. 3. Tremor. 4. Muscular weakness. 5. Nervous excitability. 6. Vertigo. 7. Graefe's symptoms (in directing the eye downward the lower margin of the upper eyelid does not follow the line of vision normally, but lags behind or follows in an irregular spastic manner). 8. Stellwag's symptoms (retraction of upper lid together with infrequent winking). 9. Paroxysmal dyspnea. 10. Intermittent vomiting without apparent exciting cause. 11. Intermittent diarrhea without apparent exciting cause. 12. Intermittent sweating without apparent exciting cause. 13. Intermittent mental depression without apparent exciting cause. 14. Psychic excitation increases the gravity of the condition. 15. Physical or mental fatigue increases the gravity of the condition. 16. The administration of thyroid extract increases the gravity of condition. 17. The administration of iodides increases the gravity of the condition. 18. In advanced cases there is practically always emaciation.

Any one, or any group, of these symptoms may be prominent early, while others, especially the goitre and the exophthalmos may be late in appearing, or may be developed to so slight an extent that they are only noticed after the examining physician's suspicion of the presence of the disease has been aroused by the prominence of some of the less common conditions. The one symptom of tachycardia, however, seems to be present in every case.

Blood Analysis.

Kocher has found some fairly uniform conditions in the blood examinations made in cases suffering from exophthalmic goitre, but they are also present in a number of other diseases. There seems to be lessened coagulability of the blood; the polynutrophiles are decreased from 75 per cent. to 35 per cent., while the lymphocytes are increased from 25 per cent. to 75 per cent. in individual cases on the day before operation, while on the day after, the neutrophiles increased from 42 per cent. to 89.2 per cent., whereas the lymphocytes decreased from 48 per cent. to 2.7 per cent.

Kocher comes to the conclusion that there is an increase in lymphocytes and a decrease in leucocytes before the operation and vice versa after operation. He characterizes exophthalmic goitre as a hyperthyreosis with glandular hyperplasia, lymphocytosis and lymphatic disturbances of the gland.

The increase in lymphocytes, however, was more often relative than absolute; the total number of leucocytes being normal or rather low.

Kocher's conclusions are based on careful blood examinations in 58 cases.

Value of Early Diagnosis.

From the practical standpoint, however, it should be stated that the diagnosis is made in almost every case a long time before the surgeon is consulted. Indeed, until very recently, too long a period of time has intervened between the original diagnosis and the surgical treatment in many of these cases, and too much stress cannot be laid upon the importance of an early operation in all instances in which a permanent cure is not obtained by internal treatment pursued a reasonable length of time.

This fact is most forcibly insisted upon by Kocher, Mayo and all other clinicians who have had a large experience in the surgical treatment of these cases, and one that should be impressed especially upon the family physician.

Although much attention has been given to the complications affecting the nervous, the circulatory and the digestive systems, because of their being directly dependent upon the disease, it must be remembered that exophthalmic goitre is not uncommonly complicated by diseases of any portion of the body. Even myxedema has been described as a complication by Simonds, Gooding, Faure and a few others, although such disease is plainly the result of a lack of physiological activity of the thyroid gland, while exophthalmic goitre is supposed to be due to a hyperthyroidism, according to Kocher, or to a toxin caused by an excessive amount of normal or abnormal thyroid secretion, according to Moebius, while Oswald and a few others think there is a thyroid insufficiency. To our minds the beautiful description of pathological findings by McCallum are convincing of the fact that there is indeed always a condition present which must result in hyperthyroidism, no matter what the exciting cause may be, and this we think is plainly borne out by the clinical picture.

Technique.

In order to produce a clear idea of a reasonably safe operation in exophthalmic goitre it may be well to describe the various steps successively.

It is important to prepare patients with a pulse exceeding 120 beats per minute, or those with a pulse which lacks uniformity, by absolute rest in bed, mild sedatives, a meat-free but nourishing diet, quiet surroundings, absence of all psychic excitation, which according to the observations and animal experimentations of Crile is capable of producing hyperthyroidism by a discharge, in some way either directly or indirectly, into circulation of an excessive amount of thyroid secretion, which in itself may cause death.

Four grains of hydrobromate of quinine, in capsules, given after meals three times daily, seems to be of some benefit in the preparatory treatment of these cases. A considerable proportion may improve so much under this treatment that an operation may become unnecessary.

Tepid baths and any other means of making the patient comfortable and contented are useful. If general anesthesia is employed this should be given so as to not excite the patient.

In order to prevent infection two precautions are important; first, the careful covering of the patient's hair, and second, guarding against infection from the mouth and nose. It is an easy matter for a patient to fill her own wound with infectious material from her mouth or nose if these are not under the careful supervision of some assistant who gives his entire attention to this matter. If the operation is performed under cocaine anesthesia this protection can readily be accomplished by placing a dozen thicknesses of sterile gauze in the form of a roller bandage over the patient's mouth

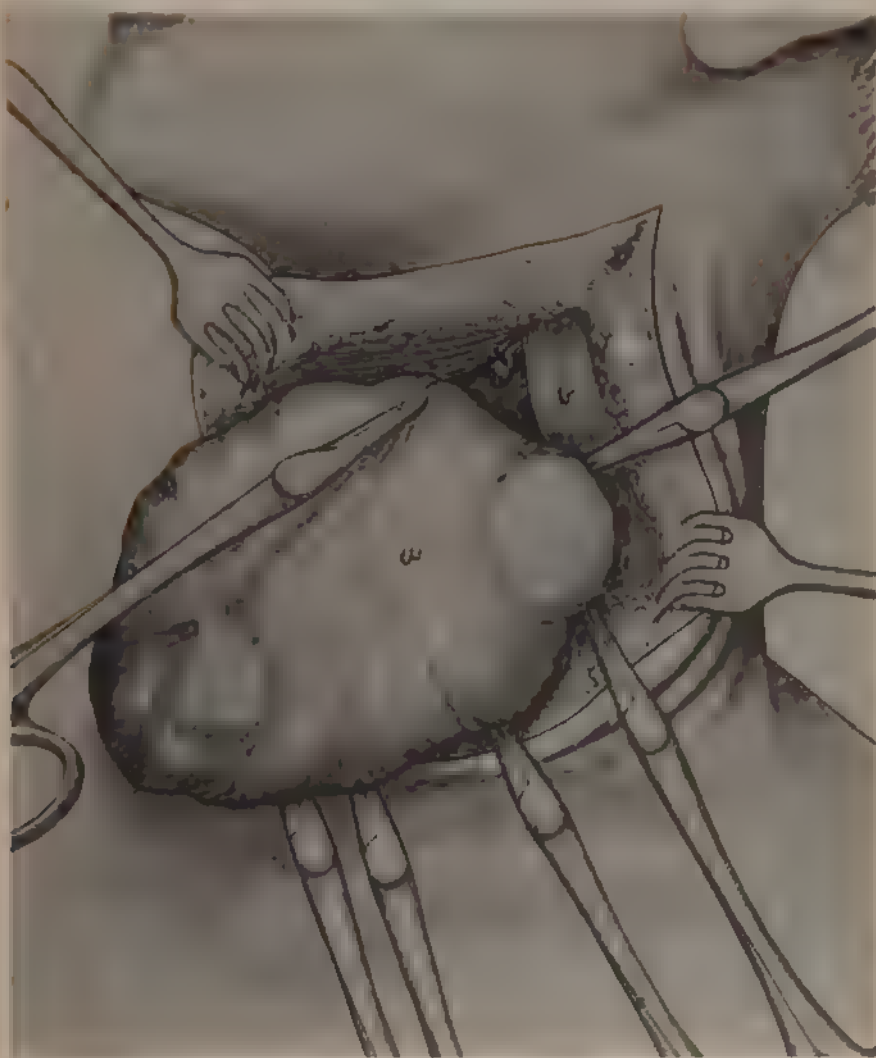


PLATE IIIa
THYROIDECTOMY

Showing large incision with primary ligation of superior thyroid artery and vein at *c*, the retracted sternocleidomastoid muscle at *b* and the dislocated gland *a*

and nose and around the head. The patient will be able to breathe through this covering but the air expelled from the nose and mouth will be filtered on its way through these layers of gauze.

If ether is used the patient should first be thoroughly anesthetized while in the horizontal position, then the head of the table should be elevated to 30 degrees, the mouth and nose covered with gauze in the manner just described, then the operation may be completed without the administration of any further amount of anesthetic, as the elevation of the head results in cerebral anemia and this in turn deepens the anesthesia to such an extent that it will last until the operation is completed if the latter be done with reasonable speed.

The curved transverse symmetrical incision of Kocher is now made with its convexity directed downwards, its lowest portion being 2 cm. above the upper end of the sternum. The skin flap, together with the platysma, is reflected upward to a joint just above the upper attachment of the sternothyroid muscles. These are now cut across at their upper end and reflected downward. This gives an excellent field of operation. It is now possible to grasp the superior thyroid vessels between two pairs of forceps and to cut and ligate both ends.

In the meantime the superficial vessels which have been encountered have all been grasped between two pairs of hemostatic forceps and have been cut and ligated.

Having severed the superior thyroid vessels on the side, of course, on which an enlargement is found or on which there are irregular nodules to which the disease has been attributed, it is an easy matter to dislocate the lobe forward. This brings into view the inferior thyroid vessels. These are again grasped between two pairs of hemostatic forceps, then cut and ligated.

At this point it is very important not to grasp the vessels too near their origin, especially on the right side, for fear of injuring the recurrent laryngeal nerve or the lower one of the parathyroid glands. Both of these structures are located between the thyroid gland and the trachea near this point, and both may easily be avoided if the above plan is followed.

The lobe is then dissected up, care being taken to leave the posterior portion of the capsule undisturbed and with it the recurrent laryngeal nerve and parathyroid gland. The isthmus is now lifted up and this exposes the inferior thyroid vessels of the other side. These should usually be treated precisely as those on the side which has just been finished, unless the disease is entirely confined to the one side. In most instances it is best to remove one entire lobe, with the exception of the posterior capsule. The isthmus and about the lower half of the other lobe should usually be removed, also without disturbing the posterior capsule.

This disposes of both inferior thyroid arteries and veins as well as the superior vessels on one side. During the entire operation all manipulations are made with the greatest gentleness in order not to press contents of the gland into the circulation or into the wound for fear of causing acute hyperthyroidism.

At the same time great care is taken to prevent hemorrhage, because Kocher has pointed out the toxic effect of blood absorbed by the wound surfaces. For the same reason every precaution is taken to stop any oozing into the wound after the operation.

The muscles are then carefully sutured in place so as to reduce the

deformity to a minimum. A small drain is inserted through the lowest point in the wound, or, better still, through a small opening 2 cm. below. The skin wound is closed with the greatest accuracy in order to prevent deformity.

Detail of Minimum Dangers.

By performing this operation in such a systematic manner the dangers to the patient are reduced to a minimum. Indeed, all of the recognized dangers are practically eliminated. Ether anesthesia which is permanently stopped before beginning to operate, removes all danger from this source. It also disposes of the danger from post-operative ether pneumonia inasmuch as the patient exhales practically all of the ether during the operation. The arrangement of the gauze bandage to the mouth and nose prevents infection from this source. Injury to parathyroids and recurrent laryngeal nerves is carefully avoided. The gentle manipulations of the gland and accurate hemostasis prevent difficulty from thyroid toxins, and the remaining portion of the gland prevents cachexia strumipriva.

There are, however, cases which are too weak to bear even this simple operation and which seem to be unable to make further progress without operative aid. In these it is well to follow the suggestions of Kocher to ligate first one vessel under cocaine and, after a few days, another, until it seems safe to remove the diseased gland.

Tuholsky in an admirable paper suggests the plan of preventing the toxic effect of thyroid secretion by ligating both superior and inferior thyroid veins. This is worthy of the attention of experimental research laboratory workers in this field.

Lowered Mortality.

For statistics the contributions of Mayo, Kocher and Crile should be consulted. They show one very important practical point which we wish to emphasize, in connection with many other, namely, that the operative mortality has decreased enormously both with the accumulation of the total surgical experience in this field and with the enlarged surgical experience of each individual operator. In the history of all surgical progress whenever this has occurred the time was near for uniform methods to become established.

The first case of exophthalmic goitre we personally operated has now been perfectly well since 1895. The patient was a young woman 22 years of age, with typical symptoms, becoming constantly worse under internal treatment. There was marked exophthalmos, severe nervous symptoms, only a moderately enlarged nodular lateral lobe and marked tachycardia. Her pulse had remained above 140 beats per minute during several weeks of observation previous to operation.

The rapid and permanent disappearance of all of these symptoms after operation encouraged me to employ surgical treatment in all cases which did not recover permanently by internal treatment, and such a course has been pursued ever since that time.

Recent Advancements.

During the past few years this subject has been taken from the field of experimental surgery and placed among those which are looked upon as fairly well settled by all surgeons who have had an opportunity to build up a fair clinical experience in this especial branch. This change has been

accomplished, especially during the past five years, through the investigations of the internist in the direction of diagnosis, through the physiologist in the study of living pathology (largely through experimental work), and by the surgeon in simplifying the technique of surgical treatment. So thoroughly have all these points been studied that it may now be reasonably expected that the primary diagnosis having been made, certain cases may be relieved permanently by internal treatment, while others will be improved only temporarily by internal treatment, and that this latter class should be subjected to surgical treatment at an early stage of the disease, before the effects of the toxins have hopelessly impaired especially the muscles of the heart and the nervous system. Under such circumstances it may be expected that there will remain only a small proportion of cases that will not be benefited either by medical or surgical treatment, that still a smaller proportion of the extremely violent cases will succumb to the disease without an operation, and only a very small percentage die after operation.

Experience has shown that with early diagnosis and proper selection of cases the mortality after surgical operation is extremely small and that this percentage is decreasing from year to year so that it will be reasonable to expect an operative mortality of less than one per cent. within a few years in the hands of competent surgeons.

In the same manner unfavorable late results are sure to decrease, as already the most dreaded ones have been practically eliminated. We no longer encounter post-operative cases of cachexia strumipriva, tetany, paralysis of the vocal cords, and but very rarely recurrence of the symptoms of the disease itself.

Conclusions.

1. The diagnosis of cases of exophthalmic goitre regarded as suitable for surgical treatment is relatively easy and should be made early.
2. All cases of exophthalmic goitre which are not relieved permanently by rest, hygienic, dietetic and medicinal treatment should be treated surgically before there has been irreparable harm done to important structures.
3. This is especially to be borne in mind in connection with a class of cases that respond readily to non-surgical treatment only to relapse at once upon the slightest strain.
4. The dangers of the operation depend largely upon the harm done by the disease before the operation.
5. These dangers may be eliminated by early operation and by preliminary treatment with rest, hygiene and diet.
6. The operative danger lies in the anesthetic, sepsis, acute hyperthyroidism, tetany, cachexia strumipriva, injury to the recurrent laryngeal nerve, hemorrhage and shock.
7. All of these dangers may be eliminated easily with reasonable skill and attention to details.
8. The patient should receive carefully directed after-treatment, with rest, hygiene and diet, following the operation until especially the blood, the nervous system and the heart have thoroughly recovered from the effects of the disease.
9. All psychic excitation should be prevented before, and for a long time after, the operation.

What has been said concerning the technique of thyroidectomy for the relief of exophthalmic goitre is true of the operation for simple goitre, with the one difference that the latter class of patients is usually in a much better general state of health. The greatest amount of danger in the former class comes from the effect the hyperthyroidism characterizing the disease has

already had upon the tissues of the patient's nervous and circulatory systems before coming under the care of the surgeon.

By neglecting all of the precautions advised against the production of hyperthyroidism during the operation it is possible to cause this condition occasionally even in operations for the relief of simple goitre; but with reasonable care this can always be avoided.

MALIGNANT GROWTHS OF THE THYROID GLAND.

Results of Operations Unsatisfactory.

Operations for the relief of malignant growths of the thyroid have been so unsatisfactory in their results that it seems doubtful whether they should be undertaken. It is to be hoped that our experience in the use of the X-rays will continue to be favorable in these cases, but at the present time nothing positive can be said in this regard. If a removal is made the same steps are to be carried out that have just been described.

In several cases we have found small malignant growths in what was supposed to be a simple goitre, and these cases have been free from recurrence, but in those in which the diagnosis was possible before the operation we have never been so fortunate and, according to Crile, this has been the general experience of surgeons.

If the enlargement in the thyroid is circumscribed, taking the form of a fibroid tumor or a cyst, usually colloid, or a circumscribed adenoma, it is unnecessary to remove an entire lobe of the gland. In this case an incision is made over the enlargement in such a manner as to produce as little deformity as possible. Then the capsule of the gland is split, care being taken to grasp portions of the capsule between two pairs of forceps before cutting it in order to prevent hemorrhage. When the nodule in question is exposed a point of cleavage between it and the remaining portion of the gland is sought and the mass is readily enucleated either with the finger, a Kocher's director or a blunt dissector. In case of troublesome hemorrhage tension is made upwards upon the forceps which have been applied to the capsule and a few stitches passed through the walls of the cavity from which the growth has been removed, and tied with just sufficient tension to overcome the bleeding. The capsule is then sutured and the skin is sutured over it. If the cyst is of large size the whole lobe of the gland should be thoroughly exposed.

If the precautions which have been mentioned in this article are borne in mind the operation is relatively very safe, unless it is done during a condition of severe dyspnea, which may occur at any time in cases in which there is much pressure upon the trachea from an acute edema of the growth. In such an event it is frequently unsafe to anesthetize the patient and then it is best to cocaineize the line of skin incision with a one per cent. solution of cocaine and to infiltrate the deeper layers with a one-tenth of one per cent. solution of cocaine in a normal salt solution. The pressure is almost always due to an enlargement of the middle lobe, and it is consequently wise to make a horseshoe-shaped incision through the skin with the convexity downward, to grasp the vessels rapidly between two pairs of forceps, to cut them, and as soon as the middle lobe is exposed, to insert into it sharp-pointed retractors with at least four teeth, the ordinary catspaw variety being the most useful, and with these to lift the lobe upwards and thus dislodge it from its location behind the sternum where it causes the

pressure which gives rise to the condition of dyspnea. After this lobe has once been dislodged the dyspnea ceases and the remaining steps of the operation may be completed without difficulty and without danger to the patient. We have found it necessary to operate upon patients in this condition in the sitting posture as in the recumbent position they were entirely unable to breathe.

TUBERCULOUS GLANDS OF THE NECK.

Direction of Infection.

In the treatment of tuberculous glands of the neck the first consideration must be the removal of tuberculous material from the body in order to prevent further infection. The glands which are first infected have progressed furthest in the changes which are due to the presence of tubercle bacilli. In the earlier stages the gland is hypertrophied and contains numerous tuberculous foci which may be separated by normal gland tissue, or a number of these foci may have developed so closely together that they will form one nodule. Presently more and more of these foci will develop in close proximity and then the nutrition of this portion of the gland will become impaired and caseous degeneration will take place. It is important to bear this in mind because in this way one can recognize the direction from which the infection has taken place, which in turn will affect the plan of treatment. The source of infection is most commonly found in tubercular foci which have developed in the tonsils. This infection may occur from particles of food containing tubercle bacilli becoming lodged upon the surfaces and within crypts of the tonsils; from particles of sputa containing bacilli lodged in the same manner; or from mucus descending from the posterior nares containing bacilli which have been lodged in this mucus from dust in the air.

Patients suffering from tuberculous glands of the neck have usually lived in surroundings in which the dust was likely to contain tubercle bacilli owing to the careless disposition of sputum of patients suffering from tuberculosis of the lungs, or they have been in the habit of drinking unsterilized milk.

Causative Influences.

In our own practice children living under unhygienic surroundings in houses containing tuberculous patients, and children coming from the farms where they live to a very large extent upon uncooked milk, are the two classes in which we have found this condition most commonly. In the vast majority of these patients we have been able to determine the presence of tuberculous foci in the tonsils in children, or in the apex of the lungs in adults. These facts are of very great importance because if they are not recognized our treatment is not likely to benefit the patient greatly, as a reinfection is almost certain to occur as soon as the patient is exposed to the influences which first gave rise to the disease.

Clinical Instance.

A young lady eighteen years of age, living at home and taking care of her three younger sisters, gives the following history, which is typical of these cases in many respects, and may well serve to illustrate the etiology and diagnosis of this disease.

Her mother died at the age of forty-two from tuberculosis of the lungs, when our patient was but twelve years of age. The father is in excellent health; her three younger sisters are also in perfect health. The patient suffered from whooping-cough, measles and scarlet fever while still young, having the last named disease at the age of six. After this time she suffered frequently from a mild form of tonsilitis, the tonsils remaining greatly enlarged and swelling to such an extent as to almost close the pharynx, making it difficult to breathe through the nose whenever they were at all congested. Shortly after her mother died she first noticed a small swelling beneath her left ear. This varied in size, but was always larger when she suffered from colds. Several months ago her general condition became impaired and she became quite anemic. At about the same time she noticed several swellings beneath the first one and a further swelling beneath the angle of the jaw on the left side. These have increased in size slowly but constantly, the latest one being located directly above the clavicle.

The patient is fairly well nourished; her appetite is fair; her tongue is clean; the bowels are fairly regular; the temperature is normal; pulse 100, full and strong; her heart, lungs and kidneys are normal. She is quite markedly anemic. There is a series of swellings extending from a point beneath the mastoid process along the anterior border of the sterno-cleido-mastoid muscle down to the clavicle; several nodules beneath the angle of the jaw on the left side; also a deep swelling apparently underneath the sterno-cleido-mastoid muscle. None of these swellings fluctuate. The examination of the blood shows the amount of hemoglobin decreased, but otherwise it is normal.

This history is a typical one in cases of tuberculosis of the cervical glands. Scarlet fever and measles are so common in this community that it would be difficult to prove a connection between these conditions and tubercular glands of the neck, but in a majority of these cases one will find that a certain amount of infection remains in the tonsils, which in turn undoubtedly makes the tuberculous infection of the lymphatic glands of the neck more likely.

In this case the oldest child was associated with her mother during the latter's sickness from pulmonary tuberculosis, the younger children being cared for by relatives. This would account for the infection of the oldest, and for the freedom from infection in the three younger daughters. The slowness in the progress of the disease may be accounted for by the fact that the child was naturally strong and healthy and that she has always lived under good hygienic surroundings, with the exception of the time she was with her sick mother. The same conditions account for the good health of her younger sisters.

The history contains one feature which is quite common in these cases, viz., that relating to the variation in the size of the glands during the early part of the infection; the increase in size corresponding to the time when the patient was suffering from cold—in other words, during the acute reinfection. Had this patient been subjected to proper treatment at this time it is quite possible that the existing swelling in the glands would have disappeared entirely, but one cannot make a positive statement regarding this, as the existing initial infection is much more severe in some cases than in others.

For four months this patient has been treated very properly by means of

internal medication. She has been given tonics, her work in school has been interrupted, and she has been out-of-doors a great share of the time. Her household cares have been reduced. She has also received some form of creosote, which is supposed to have a direct effect upon the tuberculous infection. Her general health has been greatly improved in the meantime, but there has been a slight increase in the size of the swellings, although this has been very slow.

There are two reasons why in this case this form of treatment has not resulted in a reduction in the size of these swellings, or possibly a cure. In the first place the primary source of infection is in the tuberculous foci contained in her greatly enlarged tonsils. Secondly, the degree of infection in the lymphatic glands of her neck has already advanced to such an extent that its absorption is not to be expected. It will consequently become necessary for us to relieve her by means of operative treatment.

Technique.

In this operation we must consider.

1st. The deep jugular vein, as its injury might result in the introduction of air into the circulation, causing air-embolism and death.

2nd. The carotid arteries and the pneumogastric nerve.

3rd. Some of the more important branches of the spinal accessory nerve must be preserved, because their injury results in marked deformity, due to paralysis of the trapezius muscle, and consequent discomfort to the patient.

4th. The scar should be so placed as to cause in itself as little deformity as possible.

An incision, therefore, is made along the anterior edge of the sternocleido-mastoid muscle, from the mastoid process down to the clavicle. The superficial fascia is carefully dissected back on each side of this incision. The first incision severs the external jugular vein, which should at once be caught and ligated on each side of the division, or it is still better to grasp the vein between two pairs of forceps and to cut it after it has been thus caught, and then ligate at once. The edges of the wound should now be carefully retracted and a dissection begun at the lower end of the incision. This should be carried on carefully until the sheath of the deep jugular vein is reached, which may be followed upwards until the entire vein has been laid bare from the clavicle to the angle of the jaw. The lymphatic glands are closely adherent to the sheath of the vein, but with the vein plainly in view there is no danger of injuring it if the dissection is pursued carefully.

About an inch below the angle of the jaw we find several enlarged glands. This is at the point at which the facial vein enters the deep jugular. It is a favorite location for a tuberculous lymphatic gland. Great care must be taken in dissecting out this gland as one is in danger of injuring the facial or the deep jugular vein, or both. In this instance it is possible to secure a sufficient amount of space without making a transverse incision, but occasionally it is necessary to carry the wound some distance below the lower jaw, and parallel with it, in order to remove all the submaxillary glands. It is not unusual to find the submaxillary lymphatic gland infected with tuberculosis, necessitating its removal. If this is necessary it is best to grasp the facial artery and vein between two pairs of hemostatic forceps and cut between these just below the point where they enter the submaxillary salivary gland, because in this way one can prevent some hemorrhage and

the clouding of the field of operation. To the outer side and behind the deep jugular vein the lymphatic glands are also enlarged and we will carry our dissection upwards behind the edge of the sterno-cleido-mastoid muscle. About half the distance between the lower and the upper attachment of the sterno-cleido-mastoid muscle, or at a point at which the trapezius muscle approaches the former, several branches of the spinal accessory nerve will be encountered. It is important to preserve these as their destruction will result in a drooping of the shoulder and an atrophy of the muscles of the lower part of the neck. In making the dissection from below upwards the superficial cervical nerve will be encountered passing transversely across the sterno-cleido-mastoid muscle about its middle. A little above this point the spinal accessory nerve passes out of the sterno-cleido-mastoid muscle and thence backward and downward into the trapezius muscle. The superficial cervical nerve being larger and more superficial serves as a guide to the more important spinal accessory. The latter should be carefully dissected out to its insertion in order to avoid an accidental injury.

We have now disposed of all of the enlarged glands with the exception of those underneath the upper portion of the sterno-cleido-mastoid muscle. These may be approached by making a transverse incision through the sterno-cleido-mastoid muscle, by splitting the latter longitudinally, or, better still, by dissecting the muscle entirely free and drawing it out of the field of operation by means of retractors. The last of the three methods mentioned will be followed here as it does the slightest amount of injury to this important muscle, while the other methods are undoubtedly both harmful and unnecessary.

All the infected glands have now been carefully removed. It is our practice to apply strong compound tincture of iodine to all the raw surfaces with the expectation of destroying thereby any bacilli still remaining in these tissues, and also with the idea of stimulating the tissues to increased healing. Other surgeons use different antiseptics for the same purpose, and still others use none at all, and apparently all are equally successful.

It is wise to supply some means of escape for the serum, which, during the first twenty-four hours, will accumulate from the large raw surfaces. In order that the flaps may not be separated by the accumulating serum, after once uniting, we will insert a small drain in the lower angle of the wound, and then will unite the edges of the wound, using the utmost care to secure a most perfect coaptation, because in this way we will be able to avoid as much as possible the formation of a disfiguring scar.

We are in the habit of uniting the fascia with a separate row of catgut sutures in order to avoid a depression of the scar.

Removal of Tonsils and Adenoids.

The most important part of the operation still remains, for were we to leave this patient in her present condition she would be virtually worse off than when we started the operation, as in removing the diseased lymphatic glands we have undoubtedly removed many normal ones which might serve to protect the patient against further invasions through the same source of infection—which still remains—in other words, we have not only relieved our patient of her diseased lymphatic glands, but also of many lymphatic glands which if left in place would serve to protect her. We must, therefore, remove the cause of infection in this case, which exists in the tubercular foci in her tonsils, and in the adenoids in the post-nasal space. We therefore

place the patient in the inverted position and permit her head to hang backward over the end of the table. We then insert a gag between her teeth to keep the mouth open, and then remove both tonsils; and by means of a broad, flat, post-nasal curette we curette away the adenoids, protecting the uvula and soft palate by inserting the left index finger. In order to complete the removal of these adenoids we further insert a small, ordinary, moderately blunt curette through the nostril, and, guiding the spoon with the left index finger in the pharynx, curette away all of the remaining granulations. This step is taken first through one nostril and then through the other until the pharynx is perfectly free from adenoids. At the same time we examine the patient's mouth and if she has any decayed teeth to act as a source of infection they will be removed.

After-treatment Important.

In these cases it is especially important that the after-treatment be carefully supervised by the surgeon. One of the most important features of this after-treatment consists in instructing the patient to take breathing exercise systematically. It is our practice to have these patients inhale through the nose with closed lips, filling the chest completely, and then exhale while they resist with the lips. The most convenient way of accomplishing the latter step is by placing between the lips a small tube about two millimeters in diameter. This exercise should be practiced at least twenty times in the morning and again as many times in the evening.

The hygienic surroundings of the patient should be favorable. The living and sleeping room should be high, dry and sunny. The food should be nourishing and simple and the patient should have an abundance of outdoor exercise. Tonics and anti-tubercular remedies should be given systematically until full recovery, and a patient's habits should be so formed that it becomes natural for him to live hygienically.

It is far more important that these last mentioned directions be carried out than that the tuberculous glands be removed, because if these hygienic measures are carefully followed the patient will usually live much longer and be in much better health, even though the glands be not removed, than would obtain if the glands were removed after the most perfect method and no attention paid to the dangers by reinfection. The plan which must consequently result in restoring these patients permanently to good health, and to the lengthening of their lives to the greatest possible degree, consists in removing all of the infected glands, as well as the primary foci of infection whenever this is possible; in improving the hygienic conditions and the food; and in administering tonics and anti-tubercular remedies; all of which can only be accomplished by impressing the patient with the importance of the conditions and the consequences.

The principles laid down above regarding the operation for removal and the after-treatment of tuberculous glands in the neck will apply to tuberculous glands in general without regard to the location in the body. It is characteristic for these glands to be adherent to the veins wherever they may occur, because the lymphatic glands which are most likely to be infected by tuberculosis are all located in close proximity to the larger veins of the body.

General Prognosis.

If the tuberculous glands of the neck which do not disappear under

internal and hygienic treatment, and after the removal of the focus from which the original infection has taken place, are removed, and the internal and hygienic after-treatment which has been outlined here has been followed, then the prognosis in these cases is good both as regards immediate and permanent results. If broken down tuberculous glands of the neck are not removed the degeneration may proceed to calcification of the caseous portion of the gland and the patient may still recover or adhesions may take place between the gland and surrounding structures, and the accumulation of tuberculous material may result in a sufficient amount of pressure necrosis of the overlying tissues to cause a perforation through the skin and spontaneous drainage. This may continue for a considerable time, or may be relieved by means of an operation. In the former case the patient remains ill for a long period, and if a spontaneous cure results it will be accompanied by a considerable amount of deformity.

Again, the infection may progress from one set of glands to another until all of the cervical lymphatics have become involved. Then the space occupied by the lymphatics extending from the neck into the axilla behind the clavicle may be affected and there may be a tuberculous infection of the axillary lymphatic glands; or, again, the infection may extend along the median line into the cavity of the chest. Each of these conditions is, of course, much more serious than the original infection; consequently the danger should be interrupted before it has progressed to one or the other of these unfortunate results.

During the past five years so much progress has been made in the hygienic and dietetic treatment of pulmonary tuberculosis that all that has been said above should be supplemented by directing the patient to live precisely as he would be directed to were he suffering from incipient pulmonary consumption. He should live, and especially sleep, out-of-doors, eat an abundance of eggs, beef and mutton and drink at least two quarts of milk daily, from tuberculin-tested cows, or, if ordinary milk is used, sterilize it without boiling. A sterilizing apparatus may be improvised in the poorest kitchen by the use of a fruit jar and an ordinary kettle in which a cloth has been placed to prevent the heat from cracking the fruit jar. The latter, containing the milk, should of course be placed in the water in the kettle before very much heat is applied.

The water should boil about the fruit jar at least twenty minutes.

The patient should also eat an abundance of cooked vegetables, cereals and cooked fruits, with bread and butter, but none of the non-nutritious condiments. Alcohol in every form is harmful and should be tabooed.

Use of Beck's Bismuth Paste.

In old cases that have suppurated and in which there are resulting sinuses the injection of a sufficient amount of Beck's bismuth paste every two to six days, so as to fill the sinus without overdistinging it, and closing the external opening with a gauze plug, will speedily disinfect the discharge and the sinuses will usually heal in a short time.

The tonsils and adenoids must of course be removed in these as in the other cases, to prevent reinfection.

Later it is advisable to excise the disfiguring scars marking the position of the sinuses, and to close the defect carefully so as to reduce the deformity to a minimum. It is best not to perform this secondary operation until after the sinus has been healed for at least one year, for fear of having

the edges of the wound break down after suturing, leaving an unsightly scar.

HODGKIN'S DISEASE.

The lymphatic glands of the neck frequently undergo a form of enlargement and degeneration which is probably also infectious in its character, but in which we are not able at the present time to determine the nature of the infection. The condition is rarely entirely confined to the neck, the lymphatic glands in other portions of the body being enlarged also. The glands are harder and usually more closely grouped than in tuberculosis. The patient is anemic or cachectic in appearance. Upon removal of a gland it is found to contain a uniform structure in which there are no circumscribed tubercles or foci of caseation. These glands contain an abundance of connective tissue and the spherical cells of the normal lymph gland will be seen to have lost their characteristic appearance.

This condition may be distinguished from the enlargement of the same glands due to leukemia by the fact that the blood does not show the marked increase in leucocytes that characterizes the latter disease.

The removal of the enlarged lymph glands in Hodgkin's disease does not benefit the patient except when their presence interferes with respiration by pressure upon the trachea. In a considerable number of these cases there has been a rapid disappearance of the glands under treatment with the X-ray, but it will be necessary to follow them further before anything positive can be said on this subject.

Hygiene and diet should be carefully regulated. The patient should also receive tonics and from one-half to two grains of sodium arsenate given hypodermically each day in a five per cent. solution of distilled water. This seems to be beneficial.

ENLARGEMENT OF CERVICAL LYMPHATIC GLANDS COMPLICATED BY LEUKEMIA.

The mode of differentiating between this condition and the other two forms of enlargement of the cervical lymphatics has just been described. The treatment in these cases should not be surgical in character.

LYMPHO-SARCOMA OF THE NECK.

This disease is differentiated from the other conditions which are similar in appearance, and that have just been described:

- 1st. By the absence of a history of tubercular infection.
- 2nd. By the fact that the surrounding tissues are invaded very soon after the beginning of the disease.
- 3rd. By the rapidity of its development; and
- 4th. By the early appearance of cachexia.

The excision of a sarcoma of the neck is the only treatment which has heretofore seemed to promise anything for the patient. From the anatomical conditions present in this region an extensive removal is, of course, not possible, and consequently these cases, with very few exceptions, have been hopeless; and still there are undoubtedly a few that have recovered permanently. The after-treatment with the X-ray seems to be of great importance. We have seen severe cases in which recurrent nodules have disappeared permanently.

CARCINOMA OF THE LYMPHATIC GLANDS OF THE NECK.

This is always secondary to the presence of carcinoma of some portion of the face, pharynx, parotid gland, or tonsil, which will differentiate it from the conditions which have just been described. Thorough surgical removal is the only treatment that promises anything, with the possible exception of treatment by the X-ray. The condition is, therefore, almost hopeless.

In operating every structure, with the exception of the pneumogastric nerve, that may be even slightly involved must be excised. We prefer to make the excision with the cautery in order to prevent reinfection with the carcinoma tissue and toxine.

These cases should all receive vigorous after-treatment with the X-ray.

SEPTIC INFECTION OF DEEP TISSUES IN THE NECK.

Quite frequently in infants, and occasionally in adults, there is a septic infection of the deep tissues of the neck resulting from an infection of the tonsil or some portion of the pharynx. The condition is violent in its onset and there is a severely indurated, extensive swelling which usually begins in the upper portion of the neck and extends downward. The induration is often so severe that fluctuation cannot be determined. Pus, however, is always to be found in the deeper tissues and its removal by means of an incision, and the subsequent application of drainage and a moist antiseptic dressing, results in a rapid recovery. The incision should be made carefully, because there is sometimes a displacement of the anatomical structures, and unless care is taken these are likely to be injured during the operation.

After the incision has been made through the skin and superficial fascia it is often best to separate the deep tissues bluntly until the small abscess is reached, rather than to run the risk of injuring important parts, especially the deep jugular vein.

LIGNOUS INFILTRATION OF THE NECK.

Lately a condition has been classified separately from other extensive infections of the neck because of the extreme board-like hardness of the tissues incident. The affection progresses rather slowly but causes profound distress because of the fact that the tissues are quite unyielding, having much the appearance of infiltrating skin cancer—*cancer encuirasse*.

The tissues cut like cartilage and although they are evidently filled with serum and with leucocytes the surfaces do not secrete fluid like that found upon incising skin in the presence of ordinary edema.

The tissues should be freely incised and the deep structures freely separated, much the same as heretofore described. Usually a focus of infection will be found containing a few drops of pus. A large, hot, moist dressing consisting of two parts of a saturated solution of boric acid and one part of alcohol, should be applied, and this should be covered with an impermeable substance like rubber tissue, held in place by a roller bandage. The prognosis is favorable.

TORTICOLLIS

Space will permit us to discuss only the treatment of the non-spasmodic form of torticollis, which depends upon a shortening of the sternocleido-mastoid muscle.

The form of treatment which we have found most satisfactory consists in carefully dissecting out the sterno-cleido-mastoid muscle, or what is left of it, together with the cicatricial tissue which may compose a portion of the muscle. Having laid bare the entire muscle it is split in halves longitudinally to a point within an inch of its upper, and to the same distance with regard to its lower extremity. Each half is now permitted to remain attached to one end, while at the other end of the incision through the muscle it is cut loose so that the upper attachment carries one-half of the muscle and the lower attachment the other half. The head is now turned so that the chin reaches the shoulder of the side on which the short muscle exists, in order to determine the length desired, and the two ends are united by means of a number of fine catgut sutures. After the head is turned back so that the chin is opposite the sternum the sutured muscle will appear considerably relaxed. It will give the impression of being quite a little too long. It is now covered with the superficial fascia by means of a row of catgut sutures and the skin is sutured over all. This leaves the diseased side entirely without tension. The muscle usually fills up quite rapidly, and, in our experience, the deformity has not recurred and the function has been very satisfactory.

Recently we have made an incision through the skin along the upper edge of the clavicle, thoroughly exposing the sternal as well as the clavicular attachment of the sterno-cleido-mastoid muscle. All of these attachments were then severed entirely and the muscle was followed upward and all adhesions were cut which seemed in any way to interfere with an absolutely free movement of the neck and head. Then two small drains were inserted into the angles of the wound which was then sutured. The wound in the neck made by this operation is sometimes very deep, as unless all fibres are severed the operation must fail.

The chief advantage in this operation lies in the fact that no scar is produced on the exposed portion of the neck. The disadvantage rests in the fact that any surgeon who has not witnessed the operation at the hands of a trained operator is not likely to do the work with sufficient thoroughness to give a satisfactory result.

SPASMODIC TORTICOLLIS.

Where this condition is absolutely limited to spasmodic contractions of one sterno-cleido-mastoid muscle it is proper to sever the spinal accessory nerve supplying this muscle, but in every case that has come under our care other muscles were involved and consequently such an operation could not relieve satisfactorily. In severe cases the condition is, however, so distressing that resection of the nerves supplying the muscles involved would be justified, in case the patient would be willing to exchange his distress for the resulting paralysis.

TRACHEOTOMY.

Since the introduction of diphtheria antitoxin tracheotomy is performed almost entirely for the relief of obstruction to respiration due to the introduction of foreign substances into the larynx, such as the inspiration of kernels of corn, or other objects, by children at their play, or the forcing down of the diphtheritic membrane in the attempt to introduce an intubation tube. It is also done for the removal of foreign substances that have been inspired, and for the relief of obstruction to the larynx due to malignant growths.

Technique.

The seat of the operation may be chosen either above or below the isthmus of the thyroid gland, or should the patient be in danger of asphyxiation, necessitating a very rapid operation, the incision may be made directly through the isthmus of the thyroid gland, the latter having previously been grasped between two pairs of hemostatic forceps. When the operation has to be performed with extreme rapidity it is best to place the patient in the inverted position with the head dependent so that any blood which it may not be possible to control at once will gravitate away from the opening in the trachea and will not be inspired. If sharp tenaculæ are at hand it is wise to plunge two of these directly through the skin into the trachea on each side of the median line and then to make an incision directly into the trachea with one sweep of the knife and to hold the incision open by drawing upon the tenaculæ while artificial respiration is performed. In the meantime the bleeding vessels may be caught, and if a tracheotomy tube is at hand it may be inserted. This, however, is not at all an attractive operation and should never be done except in the presence of absolute necessity. If the operation can be done leisurely the important points to be considered are:

1st. To control the hemorrhage in the successive steps before the blood vessels are cut. An incision should be made in the median line and each blood vessel caught with two pairs of hemostatic forceps as it appears in the wound, and then the incision should be continued. In this manner the operation should proceed until the rings of the trachea are plainly in view; then all the vessels should be carefully ligated and any further bleeding points caught with forceps and tied, and then the two tenaculæ should be passed through one of the tracheal rings to either side of the median line and the trachea incised longitudinally, one, two or three cartilaginous rings being cut transversely.

2nd. Should it occur that the operation is performed for the removal of a foreign body from the trachea or larynx it is wise to have an experienced assistant prepared to catch the foreign body the moment the trachea is opened, inasmuch as such a body is frequently forced out, together with a lot of tenacious mucus, the moment the trachea is incised. After this there is usually a deep inspiration which may again draw the substance into the trachea and possibly cause it to become lodged in one of the larger bronchi. And it may be difficult to dislodge it from such a point.

In the after-treatment it is wise to guard against the irritation of the lungs on account of the effect which the air has in coming directly in contact with the mucous membrane of the trachea and bronchi without first passing through the nose and pharynx. This irritation may be avoided by placing over the opening a wire frame on which a layer of gauze has been stretched, which is kept moist with normal salt solution.

The tracheotomy tube should consist of an outer and inner tube, the latter being changed frequently enough to prevent the accumulation of mucus. It is a good rule to leave a tracheotomy tube in place as short a time as possible, because some portion of the higher tube is liable to do injury to the trachea, and the longer it is left in place the greater is the likelihood of permanent injury being done to this structure.

INTUBATION.

Since the introduction of antitoxin, intubation has been found quite

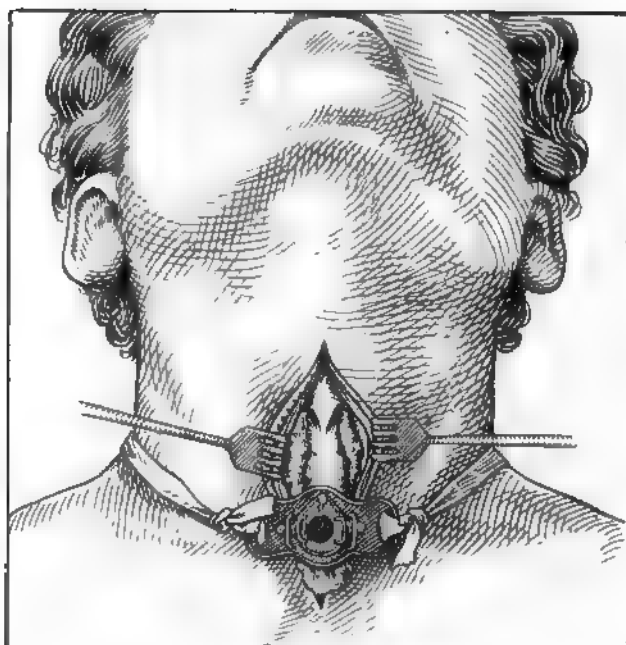


Fig. 12.

By the courtesy of Dr. George E. Brewer, representing the preliminary tracheotomy with peritracheal tamponade preparatory to performing laryngectomy.

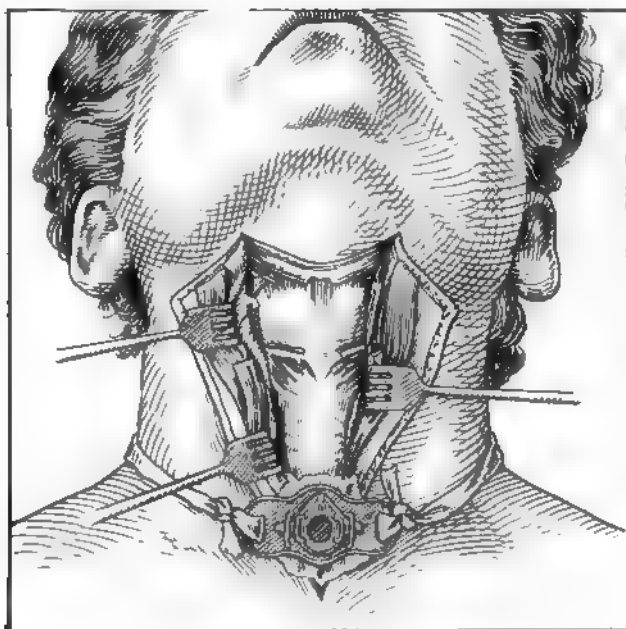


Fig. 13.

By the courtesy of Dr. George E. Brewer, representing his exposure of the larynx and thyroid membrane in his operation of laryngectomy

sufficient to relieve the obstruction of the larynx due to diphtheria. It is rarely necessary now to leave a tube in place for more than one or two or, at most, three days, because the diphtheritic membranes have usually disappeared entirely within this time if large doses of antitoxin have been given.

Accompanying Difficulties and Their Correction.

The difficulties which accompany intubation are:

1st. The danger of forcing portions of the diphtheritic membrane down into the trachea.

2nd. The danger of injuring the vocal cords.

3rd. The danger of the patient coughing out the tube in the absence of the physician, and the inability of the nurse to replace it.

4th. The difficulty some people have in taking food in the presence of an intubation tube.

5th. In rare cases the intubation tube will touch a point in the larynx, at the base of the epiglottis, which seems to produce an immediate paralysis of the respiratory centers, causing almost instant death unless artificial respiration be performed until the effect of this traumatism has passed away.

(1.) The first difficulty must be overcome by an immediate tracheotomy; consequently the surgeon should always be prepared to perform a tracheotomy before he begins intubation. This, however, becomes necessary only very rarely, but when it does the conditions are so urgent that unless the surgeon is prepared to perform tracheotomy at once the patient will probably be hopelessly asphyxiated before the necessary preparations can be made.

(2.) The second danger can be avoided by great care in performing the operation.

(3.) Since the introduction of antitoxin we have never seen a case in which the child suffered seriously from coughing out the intubation tube. Whenever this has happened there has usually been at the same time a loosening of a portion of the membrane so that a replacement of the tube was not necessary.

(4.) Patients who find difficulty in taking nourishment can usually be sustained very nicely if they are placed in the inverted position and permitted to take liquids through a tube.

The first and most important condition to be secured in order to make a satisfactory intubation is perfect rest and quietude of the patient.

Technique.

If a patient is able to move, even though to a slight extent, it will be difficult to insert the tube without causing injury to some of the parts. To secure the child so that it cannot move it is best to take an ordinary sheet, have the child's arms placed alongside the body, and then wrap the sheet around and around a number of times so that the arms cannot be removed from the sheet. In attempting to move the arms the child will pull both ways at the same time and the result will be that it will not move at all. The child should then be taken upon the lap of an assistant, its head should be held against the left shoulder, the left arm of the assistant should pass across the lower portion of the child's chest, while the right arm should hold its head firmly against his shoulder. In this way the child can be held perfectly still. The gag is then inserted between the teeth and held by a second assistant who stands behind the one holding the child. The surgeon then inserts the

first finger of the left hand into the mouth, lifts the epiglottis upwards and holds it in this position while he carries the tube mounted upon the applicator into the mouth and along the inner side of the index finger. This will guide it directly into the larynx. It is pushed down into the larynx gently and then released from the applicator by the mechanism provided for that purpose. At the same time the index finger is placed upon the tip of the tube and the latter is driven down so that the rim at its upper end rests upon the broad surface of the vocal cords. The applicator is in the meantime withdrawn quickly and this will enable the child to breathe through the tube.

It is wise to leave a firm, silk thread attached to the intubation tube and to have this passed out through the angle of the mouth and fastened upon the cheek by means of rubber adhesive strips. In this manner the removal of the tube may be accomplished by the nurse in case it should become occluded during the absence of the surgeon.

LARYNGOTOMY.

The presence of a foreign body in the larynx underneath the vocal cords, which cannot be forced out by the efforts of the patient and which cannot conveniently be reached through a tracheotomy wound, sometimes necessitates the splitting of the larynx. The same operation is occasionally indicated in the presence of benign growths located underneath the vocal cords.

The important point in this operation consists in the thorough anesthetization of the interior of the larynx by means of a spray of a four per cent. solution of cocaine in water. The patient is placed in the Trendelenburg position with the head dependent over the end of the table. An incision is made in the median line extending from a point an inch above the prominence of the thyroid cartilage to a point opposite the isthmus of the thyroid gland. This incision is carried down to the larynx, care being taken to grasp all of the blood vessels at once. Just before opening the larynx the cocaine spray should again be applied, it having been thoroughly applied just before beginning the operation. Then a sharp tenaculum is inserted on each side of the median line and while an assistant makes gentle traction upon these tenaculæ a longitudinal incision is made through the larynx. As soon as the larynx is opened there is usually a violent attack of coughing unless the part has been thoroughly cocainized. If a foreign body is lodged in the larynx the first effort of coughing usually forces it out, and the same precaution should here be taken that was mentioned in connection with tracheotomy for the removal of foreign bodies in the trachea. An assistant should be ready to sponge away any mucus that is forced out by the first effort of coughing, because this is likely to contain the foreign body.

In case the operation is performed for the removal of a growth the larynx should again be sprayed with cocaine after it has been opened in order that the operation may not be interrupted on account of coughing due to an irritation of the mucous membrane. The diseased portions may then be so perfectly exposed that their removal is not connected with any difficulty. Hemorrhage is controlled in the usual way, and after the operation has been completed the wound is closed by means of deep and superficial sutures. The deep sutures should not enter the larynx.

LARYNGECTOMY.

In the presence of a malignant growth confined to some portion of the larynx its removal is indicated if the surgeon be fairly certain that there has been no secondary involvement.

The same preparations mentioned in connection with laryngotomy should be practised in laryngectomy. If there has been sufficient obstruction to the entrance of air for a considerable time before the patient comes under the care of the surgeon to greatly reduce the strength of the patient a preliminary tracheotomy should be done so that the general condition may be improved before the radical operation is undertaken. If the obstruction is not sufficient to seriously interfere with the patient's breathing then it is just as well to do the operation at once without having made a preliminary tracheotomy.

The operation should again be performed with the patient in the Trendelenburg position, with the head dependent over the end of the table in order to prevent the entrance of blood into the trachea.

Technique.

An incision is made from a point an inch and a half above the prominence of the thyroid cartilage to a point just above the sternum. The vessels overlying the larynx and trachea are carefully caught with hemostatic forceps and cut. The isthmus of the thyroid is grasped between two pairs of hemostatic forceps, cut and ligated. After the larynx and trachea have been carefully laid bare a tenaculum may be inserted into the third or fourth ring of the trachea and the latter cut transversely. It is then rapidly drawn up and loosened so that its upper end faces forwards and acts as a curved tube communicating with the anterior surface of the neck. It is dissected loose sufficiently to project half an inch beyond the margin of the skin, which is button-holed a short distance below the lower end of the incision, so that the end of the trachea may be drawn through. This will aid in preventing the discharge from the wound from entering the trachea and causing aspiration pneumonia. It is then sutured in place by means of several fine sutures which extend through the third or fourth ring of the trachea. The upper portion of the skin incision is left open to facilitate the remaining steps of the operation necessary to remove the larynx. In this manner the patient is enabled to breathe without the danger of inspiring blood. It is also possible by placing the anesthetic upon a piece of gauze held over the end of the trachea to continue the anesthesia without annoyance.

The larynx is now carefully dissected out, beginning from below, loosening both sides simultaneously and controlling the hemorrhage step by step by means of hemostatic forceps and ligatures. It is well to keep the larynx and trachea cocaineized in order to prevent the annoyance due to coughing. When the upper end of the larynx is reached care should be taken to cut its attachment in the pharynx so that the latter can be closed by means of sutures. If the pharynx is already involved in the malignant growth the removal of the larynx is practically useless and a simple tracheotomy will be of quite as much benefit to the patient; consequently in cases proper for the removal of the larynx these flaps can be formed without fear of leaving portions of the carcinoma. The pharynx is then carefully closed, preferably with two rows of sutures, a piece of iodoform gauze is carefully tamponed underneath the wall thus formed in order to provide drainage in

case of leakage. The remaining portion of the wound is then carefully sutured by means of deep and superficial sutures.

It is usually not necessary to insert a tracheotomy tube in a trachea which has been brought out in the manner just described. The skin should be carefully sutured above and below, and it is well to protect the wound against infection from the mucus expelled from the trachea by the application of some oily substance, such as vaseline. The dressing must necessarily be small in order that the entrance to the trachea be not obstructed in any way. The same precaution should be taken against irritation from the direct introduction of air into the trachea that was mentioned in connection with tracheotomy. A frame covered with gauze should be fastened over the opening and kept moist by the application of a small amount of normal salt solution. As soon as the wound has healed an artificial larynx should be fitted into the trachea. It is claimed that a sufficient amount of air can be retained in the pharynx to give an audible voice sound, making the use of an artificial larynx unnecessary.

We have seen one case in which the patient could make all of his wants known with perfect ease, and could even engage in conversation. The total amount of air available at any time is, however, so slight that the speech is quite spasmodic.

DIFFUSE DISSECTING LIPOMA OF THE NECK.

This usually begins in the median line opposite the spurious processes of the cervical vertebræ, and becomes wider in every direction until it covers the entire posterior surface of the neck, giving the appearance from the rear of an enormous collar of fat. Laterally it advances around the neck until its two wings meet, unless an excision is made before this occurs. The tumor is lobulated, is from 1 to 5 cm. thick, and it has the peculiar quality of following the connective tissue in every direction by dissecting its way between the other structures and apparently consuming the connective tissue on its way, hence the name of dissecting lipoma. Its lobules will insinuate themselves between the muscle fibres of the neck, between the lobules of the parotid and thyroid glands and, in fact, between all of the structures which contain connective tissue.

It causes much distress from its weight and from pressure, and is extremely unsightly. The patients acquire an appearance which reminds one of the cachexia in malignant disease, although milder in form.

As soon as the diagnosis has been made the growth should be excised by means of a most painstaking, exact dissection, because if any lobules remain a recurrence is to be expected. In severe cases it is best to remove one-half of the tumor first in order to enable the patient to lie down with some degree of comfort. After the one side has healed fully the other may be operated.

These surfaces are so large that drainage is indicated, otherwise serum is likely to accumulate under the large flap and healing will therefore be retarded. The drainage may be removed on the second or third day after the operation.

THYROGLOSSAL CYST.

In some cases the thyroglossal duct has failed to become obliterated during fetal life and having a mucous lining it continues to secrete mucus.

which may be emptied either through an opening at the external end of the duct opposite the prominence of the thyroid cartilage, or into the mouth through its opening at its inner end opposite the hyoid bone, or both ends may discharge this mucus, forming a thyroglossal fistula.

Again both ends may be closed and a thyroglossal cyst form. In either event the only treatment promising relief consists in the complete excision of every portion of the mucous lining.

This lining is extremely delicate and it is possible to make a complete dissection only if the very greatest care is exercised. This is true especially because the canal is frequently not straight and the cyst wall often forms irregular pockets. The dissection may be facilitated by injecting melted paraffin (melting point of 110° F.) into the sinus permitting this to harden and then removing the cyst or sinus with its paraffin plug.

The outer opening is grasped with fine forceps and the skin surrounding the ostium is excised, together with the lining of the entire sinus or cyst, care being taken to remain outside of the cyst throughout the operation.

ESOPHAGOTOMY.

Foreign bodies frequently become lodged in the esophagus at a point behind the upper end of the sternum. Usually it is possible to grasp them with esophagus forceps and remove, especially if they are of material which makes it possible to locate them by the use of a fluoroscope, with the X-ray tube behind the patient and the surgeon in front. We have been able to pass a forceps into the esophagus, to open its jaws at the moment it touched the foreign body, and to grasp the body conveniently for removal. If this can not be done through the mouth it may frequently be done through an esophagotomy opening.

Technique.

An incision seven cm. long is made along the anterior border of the lower end of the sterno-cleido-mastoid muscle, the lower end extending to a point one cm. above the clavicle.

The skin, fascia and platysma are severed. The sterno-cleido-mastoid muscle is retracted outward and the sterno-thyroid and hyoid muscles are retracted inward, the omohyoid is severed, the outer capsule of the thyroid gland is split and the lobe of the gland is retracted upward. The deep fascia is then split, exposing the inferior thyroid artery, which extends inwards and upwards across the interior border of the longus colli muscle. This vessel is clamped between two pair of hemostatic forceps, cut and ligated. At this point the same care must be exercised in protecting the recurrent laryngeal nerve that was described in thyroidectomy. It crosses the inferior thyroid artery in the form of a delicate white thread-like structure. It is well to retract the nerve with a fine tenaculum toward the median line.

It is important to open the esophagus laterally and not anteriorly, because of the danger of wounding the nerve.

A large steel urethral sound, or an olive-pointed esophagus dilator, is now inserted through the mouth and two fine-toothed forceps are caught in the side of the esophagus, or the same result may be accomplished by placing two fine silk sutures, one cm. apart, in the side of the esophagus and

making a longitudinal incision through the wall half way between, the two sutures or forceps being used as retractors.

A large Jacob's retention catheter, or a soft rubber tube, is inserted into the esophagus through the wound and held in place by a suture. This tube should extend at least a distance of 20 cm. into the esophagus so that liquid nourishment may be passed down through it.

The wound is tamponed widely open with gauze and moist antiseptic dressings are applied and renewed every two hours, as the discharge through a fistula in the esophagus is likely to be very offensive.

If the foreign body has not been lodged long enough to cause infection, the wound in the esophagus may be sutured at once with catgut, but should nevertheless be kept widely open with tampons.

If the operation is performed for the relief of obstruction of the pharynx or esophagus above this point a permanent esophageal tube may be introduced to facilitate the feeding of the patient, or the edges of the wound in the esophagus may be sutured to the edges of the skin wound, which will enable the patient to use a removable esophagus tube later on. In most cases, however, the patient is not likely to profit much by this operation for the relief of obstruction due to carcinoma. We have never encountered a case in which the operation was necessary for the relief of obstruction due to cicatricial occlusion, although such cases are, of course, possible.

PART. IV

SURGERY OF THE CHEST.

EMPHYEMA.

The most common pathological condition of the chest for which surgical treatment is indicated is an accumulation of pus in the cavity thereof, the result of an infection due to the specific micro-organisms present in a preceding pneumonia, or to the infection of the pleura by means of the bacillus of tuberculosis, or any one of the pus-producing micro-organisms. The condition is usually preceded by an inflammation of the pleura accompanied with serous effusion into the pleural cavity, which later becomes infected. This gives rise to the formation of the pus characterizing the condition of empyema.

Signs and Symptoms.

There is usually a history of pneumonia accompanied by severe pleuritic pains, or a history of apex tuberculosis. During the accumulation of pleuritic fluid there is shortness of breath and a short, irritable, hacking cough. If the disease is due to a tuberculous infection an evening temperature is likely to be noted; if due to an infection by the pneumococcus the temperature is liable to be persistent.

There is a bulging of the side of the chest involved; upon percussion there is dullness which varies with the position of the patient, except in cases in which the two layers of the pleura are adherent above the empyema. This condition is usually not present except in recent cases, hence it is not difficult to differentiate between the late stages of empyema and hydrothorax by physical examination. If the empyema is extensive there is usually a displacement of the heart. A good-sized trocar inserted between the ribs over the middle of the area of dullness may discover pus, but the absence of pus should not be considered as proof of the non-existence of an empyema, because it frequently happens that the pus is so much thickened that it cannot be withdrawn even through a large trocar. The trocar is useful to differentiate between hydrothorax and an empyema, as in the former condition the fluid is sufficiently thin to be forced out through the instrument. In tubercular empyema there is frequently much coagulated serum which cannot be forced even through a large trocar.

Glycerine-Formalin Solution.

Murphy has demonstrated that in a large proportion of cases which come under treatment reasonably early the empyema will absorb and leave the patient in an ideal condition if a portion of the pus contained in the pleural cavity is withdrawn and the following solution injected through the trocar: viz., a two per cent glycerine solution of formalin which contains

forty per cent of formaldehyde. It is always kept ready for use so that it is never necessary to use this preparation recently mixed. This is important because in the freshly prepared solution there are always little globules of formaline which will cauterize any surface with which they come in contact, while in the mixture which has stood for a number of days the solution is perfect and this accident does not occur. From ten to sixty c.c. of this solution is injected into the pus remaining in the chest cavity after a portion of the pus has been removed through a trocar to which a rubber tube at least thirty cm. long is attached to prevent the patient from filling the chest cavity with air by some sudden inspiration. The progress of the case determines the time at which this treatment is to be repeated, and the number of repetitions.

Anesthesia.

In the presence of pus in the pleural cavity in cases not yielding to the treatment just described, an operation is always indicated. If the patient's condition does not warrant the use of a general anesthetic the operation may be performed with the use of a one per cent. solution of cocaine injected into the skin and into the sheaths of intercostal nerves a slight distance above the point at which the operation is to be done. The point to be chosen for the operation is the middle of the area of dullness, usually about the sixth or seventh rib.

Technique.

An incision from two to six inches in length is made parallel with the rib in the posterior axillary line. A longitudinal incision is made through the periosteum and this is removed by means of a periosteal elevator. A pair of bone-cutting forceps, or especially devised rib-cutting forceps or shears, is then carefully applied to the rib of the posterior end of the wound; the rib is cut off, grasped by a pair of bone-holding forceps and lifted out of its periosteum to the extent to which its removal is desired. It is then cut off at this point with the bone-cutting or rib-cutting forceps. The periosteum of the rib and the pleura now lie between the abscess and the operator. If the empyema has existed for a short time only it is not necessary to remove more than one segment of rib, but if it has existed for a considerable period it is often wise to remove a portion of two or more ribs at once in order to insure a sufficient amount of space for permanent drainage, as well as to provide for a certain amount of contraction of the chest wall.

Drainage and Non-irrigation.

A longitudinal incision is now made through the middle of the periosteum in order to avoid the intercostal vessels and nerves. This will permit the pus to escape from the pleural cavity. It is well to make this incision sufficiently large for perfect drainage. By inserting the finger through this opening one can determine accurately the extent of the pus cavity. A long pair of dressing forceps is now passed through this opening, across the cavity explored, and its end is forced out between two ribs on the anterior surface of the chest wall at a point suitable to the conditions present. An opening is cut down upon the forceps and two perforated rubber drainage tubes at least half an inch in diameter are drawn through this opening into the chest and out of the original incision behind. They are protected by means of safety pins at each end, and after the pus has

been permitted to escape a large dressing composed of aseptic gauze and absorbent cotton is applied over both openings. Neither irrigation nor sponging is made use of. This dressing is changed as frequently as soiled, but irrigation is not practised at any time.

In large accumulations of pus in the pleural cavity, especially if there is a communication between the abscess and a bronchial tube, it is often not safe to operate with the patient in the recumbent position. In such a case it is best to aspirate most of the pus through a trocar at least two mm. in diameter or to operate with the patient in the sitting posture.

In these cases, furthermore, the operation should always be performed with the greatest possible rapidity.

After-treatment.

In the after-treatment it is important in the first place to secure perfect drainage, which is insured in the operation which has been described from the fact that the drainage tubes extend entirely across the pus cavity and consequently when the diaphragm encroaches upon this cavity from below and the lung from above the through drainage persists. Were there but one opening in the chest wall a pocket might readily form at some point, but with the precaution of having two openings with drainage tubes extending from one to the other this cannot occur.

It is important to make the dressing large enough to completely close the opening against the entrance of air from without and to insure this by carefully applying bandages around the dressings to hold them in the desired position.

After the discharge has been greatly reduced it is wise to begin giving the patient systematic breathing exercises. He should be directed to inhale as fully as possible through the nose, keeping the mouth closed, and then to blow out forcibly through a tube with an aperture of about two millimeters diameter. These exercises should be frequently repeated during the day. It is well to continue in this respect for many months after the patient has recovered, because it will aid in overcoming the deformity which is sure to be present to some extent after the operation.

Danger of Supervening Tuberculosis.

Even in cases of empyema not complicated with tuberculosis there is always a greater tendency to the development of this disease than in normal lungs; consequently these patients should be advised to live under favorable hygienic surroundings and they should be given general tonics whenever their condition of health requires. If there is any suspicion of the presence of tuberculosis anti-tubercular measures should be used for a long period after recovery from the operation. If the empyema has resulted from a traumatism, such as a penetrating wound, especially a gunshot wound made with ordinary firearms, the infection is frequently due to the fact that some portion of clothing has been carried into the pleural cavity and consequently it is well in these cases to make the opening in the posterior axillary line sufficiently large to enable a surgeon to examine the cavity for such substances.

Continuance of the Drainage.

It is well to leave the drainage tubes in place until one is certain that the entire cavity has been closed down to these, because if they are left in place a little too long no harm can come from it, while if they are re-

moved too soon a new pocket of pus may form, necessitating a secondary operation. If it seems desirable to reduce the size of the drainage tube it is well to draw smaller tubes through the entire distance so that the through drainage is maintained as long as drainage is made use of. If the granulations in the space occupied by the drainage seem flabby or unhealthy it is good practice to drop a small quantity of strong compound tincture of iodine into the cavity in order to produce a stimulating influence.

Although these cases usually progress favorably occasionally one is encountered in which healing is greatly retarded, or in which fistulæ or abscesses have persisted for a long time after the original operation.

FISTULA AND ABSCESES FOLLOWING OPERATIONS FOR EMPYEMA.

Although the relative proportion of persistent fistulæ and abscesses is not so great as formerly after operations for the relief of empyema of the chest, since surgeons take the same precautions as in aseptic cases to prevent secondary infection during and after this operation, they are still sufficiently common to be a source of much annoyance to the surgeon.

There are, of course, other elements of value from the standpoint of prophylaxis, aside from that of aseptic operation and after-treatment.

The method advised by Murphy of aspiration and subsequent injection into the pleural cavity of 60 cc. of a 2 per cent. solution of formalin in glycerine, and the plan of making tubular through drainage in case of operation instead of simply making drainage into the pleural cavity, should be mentioned especially. The former method of treatment makes the latter unnecessary in many cases, and the latter method reduces the number of persistent fistulæ and abscesses to a minimum, because it eliminates the formation of pockets.

Beck's Bismuth Paste.

In cases in which these sinuses or abscesses persist, however, in which formerly the method of Estlander and Schede gave the most reasonable promise of ultimate success, surgical treatment has often been most disappointing. It is just in this class of cases that the method introduced by Dr. Emil Beck has given the most satisfactory results.

The method consists in filling the sinus or pus cavity with a mixture of bismuth subnitrate and keeping this in position by plugging the outer opening with gauze. The mixture consists of one part of arsenic-free subnitrate of bismuth and two parts of sterile amber vaseline.

This mixture is injected every second day until suppuration has disappeared. The injections are repeated as often as necessary to keep the sinus or pus cavity constantly filled with the preparation. At first it is necessary to do this every day or every second day, then every third and so on until it may be necessary to inject not oftener than once a week or ten days.

We have employed this form of treatment in many cases and it shows results which are much better than those obtained previously.

One feature has been most striking. In cases that were in a septic condition when the treatment was commenced, the improvement of the general condition of the patient was especially marked. Pulse and temperature became normal within a few days and the general appearance of the

patient lost the characteristics of sepsis. The nutrition improved and the anemia disappeared rapidly. The discharge from the sinuses usually becomes sterile in a short time.

To illustrate this a short abstract of the history of the following case will be typical.

An Illustrative Case.

A. S., an Italian laborer, 60 years of age, had a pneumonia followed by empyema of the right thorax seven months ago. The pleural cavity was drained; a sinus persisted, leading into a large cavity. Three months later Estlander's operation was performed with excision of three ribs. The patient was in a severely septic and anemic condition when he entered the hospital. An injection of 720 cc. of the bismuth mixture was given and the patient put to bed. In two days 60 cc. more was injected, but by this time the septic condition had markedly decreased, and within a week the patient became normal and his anemia began to disappear. For one month injections were made every second day, the quantity in the meantime decreasing to 35 cc. and the patient acquired a rosy appearance. Then he was sent home,—at first, to return twice a week to have a few cc. injected, and later only once a week, a sufficient amount being used each time to fill but not to distend the cavity.

Nine months later his general health was perfect and there was but a superficial sinus which holds scarcely 5 cc. of the paste, and which would undoubtedly heal completely in a short time.

A second case seems worthy of special description because it is one of those that were formerly extremely difficult to heal.

History in Abstract.—F. C., American, age 35, miner, had a severe fall nine months ago while working in the mountains; this was followed by pneumonia and then by a right-sided empyema. This was drained through a rib resection opening. Seven months later an Estlander operation was made, with resection of three ribs. At the end of two months the patient came under our care. At this time there was a sinus discharging pus freely, and the patient coughed up the same material. This was before we were familiar with the bismuth paste treatment—so performed Schade's operation. The patient did well for nearly a week, when he developed a phlebitis in both femoral veins. He became markedly septic and emaciated. Four weeks later he still expectorated pus, and there was a free drainage of pus from the wound when we began the injection of No. 1 bismuth paste. He expectorated much of the 650 cc. of the paste injected. The injection was repeated, each time simply filling the cavity without using any force. The pus and sepsis subsided rapidly. In ten days he appeared like a different person, and in twelve weeks he was perfectly well.

Conclusions and Further Details.

This treatment has proven most satisfactory. We have used it only in cases with sinuses, although it has been suggested to aspirate the pus in empyema and to inject the paste into the pleural cavity through the trocar.

There has been no case of bismuth poisoning in our series of cases, although this might easily occur—as it has when cavities in other portions of the body have been filled with large quantities of bismuth paste. If this occurs, Beck advises the immediate injection of hot olive oil, 110° F., which will dissolve the paste and facilitate its escape through the outer fistula or through a drainage tube, which may be inserted.

The injection is made with a large, ordinary glass syringe, just enough force being employed to fill the sinus or cavity, but not enough to cause forcible distension. The outer opening is carefully plugged with sterile gauze.

In a few cases of empyema, accompanied by tuberculous cavities of the lung, in which the patient came under treatment in a severely septic state, with a communication between the sinus and the cavity in the lung, so that the patient would expectorate the bismuth paste after injection, we have had remarkable improvement.

The paste seemed to result in a disinfection of the sinus and cavity so that the symptoms of acute sepsis disappeared, which gave the patient an opportunity once more to collect some strength to withstand the tuberculosis.

CHRONIC EMPYEMA.

Conditions Favoring This Disease.

The drainage, followed by the use of Beck's paste, of an empyema of the chest does not always result in the complete cure of the empyema. This may be occasioned:

1st. By the contraction of the lung to such an extent as to leave a considerable space which is not filled by re-expansion.

2nd. By the unyielding condition of the chest wall.

3rd. By the fact that there are sometimes a number of abscesses separated from each other by adhesions between the pulmonary and the costal pleuræ. It happens occasionally that only one of a number of these abscesses is opened, and then the drainage of that focus can, of course, not relieve the other abscesses. Frequently there are small sinuses communicating between the different pus formations so that there is a constant flow from an undrained abscess into the drained one; or this communication may from time to time become obstructed and then the drained abscess will approach complete healing only to have a new discharge of pus into it from its undrained neighbor. In such instances it is usually possible to locate the other abscesses by means of percussion.

Again the healing may be prevented because of the inelasticity of the thickened pleura which prevents it from applying itself to the surface of the lung. It frequently happens that the costal pleura is several centimeters in thickness. There may also be a necrosis of one or more ribs secondary to the pleuritic infection, which may again account for the fact that healing does not take place. In still other cases there is a constant reinfection from a tubercular abscess in the lung which perhaps did not directly communicate with the empyema at the time of the operation. All of these conditions, with the exception of the last one, can be relieved by a proper operation, which must have in view the application of the chest wall, or what is left of it, to the surface of the lung.

Technique.

The operation to be chosen must depend upon the extent and location of the empyema. If this is confined to the lower portion of the chest cavity an excision of a number of ribs, beginning with the seventh, eighth or ninth and going upward until the upper edge of the empyema is reached, will usually suffice. The thickened pleura should be removed at the same time. The intercostal arteries should be ligated in this operation even though no

hemorrhage takes place at the time of the operation, or they should at least be crushed with clamp forceps because they frequently begin to bleed after the patient has recovered from shock, unless they have been properly disposed of.

If the empyema extends up to a point above the level of the lower angle of the scapula then it is usually wise to make a large flap of the chest wall with its base upward, cutting through the skin, the muscle, the ribs and the pleura, and cutting away a sufficient portion of the rib ends to permit this flap to sink into the cavity. Here again the intercostal arteries should be cared for. It is usually wise to apply a large tampon composed of aseptic gauze to the entire cavity and to lay the large flap which has thus been formed upon the surface of this tampon and then to apply a large dressing over it. This tampon is left in place for a sufficient length of time to stimulate the growth of vigorous granulation tissue over the under surface of this flap as well as over the surface at the bottom of the cavity. After the tampon has been removed the flap is placed in this cavity and permitted to heal in place. In this operation again it is often wise to excise a thickened pleura. If the condition is due to the presence of necrotic ribs these should be removed. If it is due to a reinfection from a tubercular lung either of the methods which have just been described may be used, but they are usually not followed by a complete recovery. Occasionally it seems best to treat a chronic empyema by laying the cavity widely open by one or the other of the methods just described, to apply a large tampon to the cavity thus exposed and to reduce this tampon slowly until the entire cavity has healed from the bottom. In chronic empyema we should say that the most important point consists in making the operation thorough enough.

Even after this operation sinuses sometimes persist and these should then be treated by the injection of bismuth paste after the method described above. In our recent experience the results have been very good even in the cases which formerly appeared almost hopeless.

OPERATIVE TREATMENT OF UNILATERAL LUNG TUBERCULOSIS BY TOTAL MOBILIZATION OF THE CHEST WALL, BY MEANS OF THOROCOPLASTIC PLEURO-PNEUMOLYSIS.

The many attempts by surgical means (by injection, opening of the cavity formed, or by resection of the rib, and part of the lung) to cure pulmonary tuberculosis have proven very unsatisfactory because the slow process of healing makes it a relatively hopeless process.

Murphy, Forlanni and Brauer by artificial pneumothorax caused compression of the lung tissue with reduction of size of cavity and immobilization of the affected lung tissue.

Brauer states that adhesions occur in one-fourth of all cases of pulmonary tuberculosis, therefore, nitrogen, if introduced between the pleuræ, is an impossible procedure in a large majority of cases. Other methods of reducing the volume of the lung and shrinking of cavities in the lung tissue have been attempted.

Brauer advocates loosening of adhesions by surgical interference, and then reducing the volume of lung by introduction of nitrogen between the layers of pleuræ. Friedrich objects to this method because the pleura remains thin in spite of adhesions, and during manual separation without aid of sight there is exceedingly great danger of tearing the lung tissue.

Also because of the following complications: Empyema of the pleuræ, mediostinitis, which markedly endanger the patient's life.

Friedrich speaks of a case in which there was a large cavity, which, on draining of mild serous pleural exudate, became an extensive pleural suppuration, terminating fatally in a few weeks.

FRIEDRICH'S METHOD FOR MOBILIZATION OF CHEST WALL BY MEANS OF TOTAL REMOVAL OF BONE WITH PRESERVATION OF PLEURA COSTALIS.

In young individuals the operation has a tendency to produce marked shrinking of the lung on the side on which resection is done and drawing the opposite lung, heart, mediastinum, diaphragm and clavicular fossa toward the shrinking lung, which produces hindrances in the process of recovery.

For this reason efforts should be directed to prevent this tendency of shrinking of an extensively involved lung. This difficulty is overcome by extensive rib resection if the chest cavity is allowed to be closed.

Although most patients have fever and considerable expectoration, no antipyretics or expectorants are given, but efforts are used to increase appetite and to improve the gastro-intestinal functions.

Confine patient to bed—give definite physical and X-ray examination.

Technique.

On day of operation, nothing by mouth except a cup of tea in the morning. Twenty minutes before the operation give hypodermic of .015 to .02 morphine muriate.

After this and before the anesthetic is commenced all possible expectoration is encouraged for a long time to free the bronchi and caverns of secretion and diminish danger of aspiration during the anesthesia.

Place the patient in a semi-oblique position with the body turned half over on well side with the arm held vertically up in the air.

Disinfect the surgical field very thoroughly with soap, ether and alcohol.

Incision is made similar to that in Schede's method of thoracoplasty in empyema, the muscle being rendered analgesic by Schleich's infiltration method. Then a flap is formed by beginning the incision three fingers' breadth external to edge of the sternum at the height of second or third rib; it is carried downwards external to the nipple to the tenth rib, posteriorly up again to the second dorsal spine. The line of incision is varied occasionally for cosmetic reasons.

In dividing the serratus magnus muscle the ends of the serrations are allowed to remain, otherwise the whole muscle with the vessels and nerves is rapidly displaced upward. The pectoralis major and latissimus dorsi are deeply niched and drawn strongly aside with retractors.

The bony chest is now all exposed. Then with greatest rapidity the ribs are resected, leaving periosteum and intercostal muscles behind, being, however, all the time careful not to puncture the pleura costalis, as a pneumothorax at the present stage would greatly endanger the patient, as a marked increase in secretions of the caverns would greatly promote suppuration. This accident is very much more easily avoided by using the positive or negative air-pressure apparatus of Brauer or Sauerbruch.

After detachment of the second to tenth ribs from the anterior carti-

lages to the spine, and especially after the attachments of second and tenth ribs gives way, the whole lung covered by the intact pleura costalis sinks back toward the hilus, and in operations on the left side, the heart can be seen rising above the level of the lung surface. By practice such rib resections as these—removing in all 180 to 220 cm. of bone—can be done in twenty-five minutes.

After removal of projecting pieces of intercostal muscles, nerves, and periosteum, and careful hemostasis, the flap of muscle is carefully approximated with twenty to thirty buried catgut sutures. Skin sutures with silk are applied and a thick drainage tube is inserted along the spine.

Little General Anesthesia Required.

As a rule, if all these conditions are carefully attended to during the operation the patient should have a good pulse on leaving the table. Inhalation anesthesia is only necessary when rib resection proper is commenced, provided morphine and infiltration anesthetic has been previously used. The anesthetic is given in restricted amount so that bronchial and laryngeal reflexes remain, in order to facilitate expectoration, while pain is not felt. An experienced anesthetist can do this with 5 to 15 gms. of chloroform.

The Heart-effect.

A mildly compressing aseptic dressing and bandage is applied and patient put to bed in a prone-oblique position. The most important factor during the following hours and days is the behavior of the heart, which on account of change in volume has suffered more or less dislocation in position and with the collapsed lung it is subjected to pressure of the air on the opposite side.

The preservation of the costal cartilages is important in preventing dislocation from acting too much upon the heart. The disturbance in the heart action is similar to that found associated with severe contusion of the thorax and known as *delirium cordis*, characterized by increased rate, diminution in size, and absence of pulse. If the heart is energetically stimulated with digitalis intravenously, caffeine and camphor and normal salines subcutaneously, the patient is usually brought safely through the dangers.

The course of wound healing is usually smooth. In six to ten days the drainage tube is removed, and healing by primary union is obtained.

Dyspnea is the rule during the first few days following the operation, due to the fact that the lung on the opposite side has to do all the work for both, besides being interfered with by pressure of the air on the opposite lung and the heart. This disappears in a few days.

As the wound pain disappears expectoration recurs and is facilitated by pressing the hand against the immobilized side, thus aiding the removal of contents of caverns.

The temperature and amount of sputum fall rapidly as soon as expectoration has begun.

In unilateral pulmonary tuberculosis, fibro-cavernous in type, occurring in young and middle-aged persons, with various degrees of fever, and in which climatic, dietetic, and medicinal measures have been of no avail in staying the progress of the disease, the operation is indicated.

The degree of temperature and amount of sputum have no influence in the indications.

(Be conservative in cases of multiple tuberculosis, especially if associated with intestinal tuberculosis.)

The danger of the operation lies in the increased demands upon the heart.

TUBERCULOSIS OF THE RIBS.

This condition may occur primarily or secondarily. In either case it results in abscess formation and later on to formation of sinuses leading down to diseased bone. It is occasionally possible to secure healing by making a free incision over the middle of the diseased rib reflecting the periosteum and curetting away the diseased tissue, but usually nothing short of excision of the rib will suffice.

ACTINOMYCOSIS.

The Positive Sign.

In the United States empyema caused by an infection with the ray fungus is not so very uncommon and should constantly be borne in mind as one of the possibilities, especially as the treatment must be entirely different in case actinomycosis is present. This condition can be recognized by the presence of little yellowish flakes in discharge from the empyema which contain the characteristic ray fungus, easily demonstrated by microscopical examination.

The Curative Value of K I. and Dosage.

In cases suffering from actinomycosis it is important to bear in mind the fact that this disease is curable by the administration of very large doses of iodide of potash. Small doses are of little benefit. It seems necessary to saturate the blood thoroughly with this drug in order to destroy the parasite. The method which we have found most useful consists in the administration of sixty to ninety grains of iodide of potash in a glass of warm milk three times a day, preferably at 6 a. m. and at 2 and 10 p. m., in order to have the periods eight hours apart, followed by a pint of hot water. In this way the drug may be given in these large doses without causing any marked disturbance. It is used for three days in succession; then the patient is permitted to rest for the same period of time, when the administration is again repeated. After about six weeks of treatment these cases usually recover perfectly unless an undrained abscess be present. In such event some of the parasites seem to remain where the drug does not reach them and from that point a reinfection may take place; consequently it is wise to repeat the treatment a number of times after permitting the patient to rest for a month or two, when he has arrived at what is considered a complete cure. This precaution is especially needful in patients who live at a distance so that they cannot be kept under observation conveniently. We have personally lost one patient because this precaution was neglected. In a second case in which the disease was located in the neck the patient returned after one year with a recurrence, complicated with an edema of the larynx which nearly proved fatal. Renewed treatment with ninety grains of potassium iodide again relieved the patient, who has now been well for eight years. After being apparently well the remedy was given for three days each month for six months.

Purity of the Drug.

It is to be borne in mind that small doses of potassium iodide are absolutely useless in the treatment of this disease. Furthermore, it is of the

greatest importance to use a preparation of potassium iodide which is absolutely pure. Most of this drug as obtained in the market seems not to be perfectly pure, and while in my experience ninety grains can always be given when the pure drug is used many patients cannot take even much smaller doses of the ordinary drug.

ABSCESS OF THE LUNG.

Physical Signs.

Following pneumonia or an infection in some other part of the body, such as puerperal infection, an abscess in the lung not connected with the pleural cavity may occur. This may communicate with a bronchus and may evacuate itself thereby from time to time, or it may remain circumscribed within the lung tissue. It is relatively easy to recognize this condition if the abscess cavity communicates with a bronchus because its filling and emptying can be observed. If it is near the costal surface of the lung it may be recognized by percussion, giving much the same sound that is obtained upon percussion over the surface of the liver. If the abscess is not at the edge of the lung resonance will be observed above, below and to each side of it, giving the impression of a circumscribed space filled with fluid. Its presence usually gives rise to an abnormal temperature, which frequently reaches 104, 105 and 106° Fahrenheit.

In the more serious cases a considerable portion of one lobe, or the entire lobe, may become gangrenous from the presence of an infarct.

One of the larger vessels may be completely obstructed by a thrombus so that a considerable portion of lung tissue becomes necrotic. In these cases there is always a very marked odor as soon as the products of this decomposing lung tissue are expectorated. The expectorated material usually has the character of thin, sanguineous pus, which is quite characteristic.

Danger of Lung Collapse and Its Prevention.

The rational treatment must, of course, consist in the evacuation of the abscess externally. There is, however, one great danger in this operation resulting from the fact that in order to approach the abscess the pleural cavity must be opened, and if an adhesion does not exist between the pulmonary and the costal pleura the lung is likely to collapse. This condition frequently results in the death of the patient, and in order to guard against it the surgeon should be prepared to inflate the lung through a tube inserted into the larynx, constructed so that its ends will fit tightly between the vocal cords. Its top should be connected with bellows by means of which the collapsed lung may be inflated. The apparatus known as the Fell-O'Dwyer is very simple and efficient, and this, or a similar one, should always be procured whenever the operation here mentioned is undertaken.

Technique.

A U-shaped incision should be made over the area covering the abscess and the flap turned back, exposing two or three ribs. Portions four inches in length of at least two ribs should be resected with great care, in order not to penetrate the costal pleura until sufficient space has been secured to repair the mischief which might occur from the sudden collapse of the lung. After this area has been laid bare the portion of lung opposite may be grasped by means of fine volsellum forceps through the costal pleura, or fine stitches of catgut may be passed through the costal pleura and the adjoining

lung at several points, or an apparatus for inflating the lung may be applied and the lung filled with air by compressing the bellows, and then the costal pleura may be opened and the lung sutured to this opening, or it may be sutured to folds of iodoform gauze which are drawn over the edge in the opening in the costal pleura so that the lung cannot be retracted.

A method which has been very satisfactory consists in suturing with catgut pieces of wet gauze to the parietal pleura and lung around the edge of the opening before the pleura is opened; the moist gauze prevents the entrance of air and consequently pneumothorax cannot occur. The abscess is then best entered by means of the actual cautery, because the opening thus made will enlarge when the eschar caused by the burn becomes separated.

Upon introducing the finger into this cavity bands will be found to pass through it which the surgeon attempts to break down in order to reduce the entire space into one cavity. These bands frequently contain large blood vessels and it is consequently best to apply hemostatic forceps to them and to cut between these. The cavity may be drained by inserting a few strands of gauze; then the wound is dressed as in the operation for the relief of empyema.

In case the abscess of the lung approaches the pleura, adhesions between the pulmonary and the costal pleuræ have usually formed so that there is no danger from the formation of pneumothorax, but it is never safe to operate in these cases without being prepared to find no adhesions present. Here again a large dressing is indicated, and it is wise not to permit the external wound to heal too soon after the operation.

GUNSHOT AND STAB WOUNDS OF THE CHEST.

In the treatment of gunshot or stab wounds of the chest it is, first, important to determine whether there is dangerous bleeding from the intercostal vessels or from the internal mammary artery. The former can easily be exposed, clamped and ligated. The latter, being located near the sternum between the costal cartilages and the pleura, is in a position in which it is difficult to ligate without fear of causing pneumothorax by opening the pleura. The fact that this vessel is given off from the subclavian artery makes the hemorrhage very formidable, and the further fact that it is located behind the costal cartilages makes a hemorrhage into the pleural cavity more likely than an external hemorrhage. In case of bleeding from the internal mammary artery it is necessary to remember that the costal cartilage can be easily cut with an ordinary scalpel and that the external wound is of no importance, consequently a large external wound should be made over the costal cartilage of the next rib above the point of injury, this cartilage should be carefully cut away for a distance of at least an inch over the point at which it crosses the artery, and then a fine stitch should be passed around the artery and tied. The danger from trying to perform this operation through a small external wound is very much greater than it is if ample space be secured by making a large one.

The hemorrhage from these two sources having been disposed of the next important point is to secure, as nearly as possible, complete rest of the chest walls. This can best be accomplished by applying a plaster-of-Paris jacket extending from the lower border of the ribs up over both shoulders. The patient will immediately begin to breathe by using the diaphragm alone and the irritable hacking cough will in most cases subside, and therefore the

patient will stop pumping blood from the lung tissue into his pleural cavity. If empyema follows through an infection caused by the injury it should be treated according to the method which has already been detailed.

Do Not Probe: Apply Chest Splint.

This point should be borne in mind above all things—that under no condition should a wound of the thorax be examined with a probe, because probing is one of the chief sources of infection. If plaster-of-Paris is not available, or if the patient does not seem sufficiently strong to bear its application, a protecting cast may be constructed in a few minutes by winding long strips of rubber adhesive plaster, from two to three inches in width, about the entire chest, beginning at the border of the ribs and working upwards until the whole chest and shoulders are covered. Several layers of this plaster may be applied to advantage. It is surprising how quickly a patient who has not been able to rest for a moment on account of the irritation due to the motion of his chest walls, will become quiet and fall asleep after one or the other of these jackets has been applied. Cases which have so far advanced that the danger of new hemorrhage is over, but in which the blood in the pleural cavity is not absorbed, should be aspirated through a trocar or drained by open incision or treated like an empyema.

Value of the Chest Splint.

The same treatment with rubber adhesive plaster strips acts quite as beneficially in patients with severe injury to the ribs due to contusion. A man sixty-two years of age was caught under an upturned vehicle and rolled between the ground and the vehicle, resulting in a number of ribs being broken at various places. When we saw him at his home twelve hours later his pulse was imperceptible, he was severely cyanosed and only with great difficulty could he gasp for a little air. He was almost unconscious from exhaustion although his head had not been injured. As soon as the rubber adhesive plaster cast had been applied the patient began to breathe regularly and quietly, although, of course, entirely with his diaphragm; his pulse came back, beating 180 per minute. Within an hour it had been reduced below 100 per minute. He became perfectly conscious at once and made a thorough recovery. We have seen many similar though less severe cases.

PNEUMOTHORAX.

If the wound in the chest wall has been sufficient to admit a quantity of air the lung will become compressed and a pneumothorax will be formed. All that is required for the relief of this condition is the closure of the external wound, unless there has been a complete collapse of the lung, in which event the lung should first be distended by means of inflation before the opening in the chest wall is closed, or the opening may be closed and the air contained in the chest cavity may be aspirated by a pump through a trocar. If, however, air is forced into the pleural cavity from the lung itself by the injury of the lung tissue then it may become necessary to make a rib resection, to grasp the injured point of the lung with forceps to draw it to the external wound and there to attach it, after the manner described in the operation for abscess of the lung. The wound in the lung, however, is usually so small that it closes spontaneously, or it is so large that the patient succumbs before the surgeon has an opportunity to secure relief by an operation.

The Fell Bellows.

Dr. George Fell has invented a form of negative pressure bellows attached to a bell which can be placed over the opening in the chest wall and by means of which a vacuum may be secured which will immediately remove any air that has entered the chest cavity through an opening in the chest wall. This vacuum can be maintained indefinitely until the wound in the chest wall has closed spontaneously, or sutures may be inserted before the airpump has been applied, and when all of the air has been withdrawn from the pleural cavity these sutures are drawn tense and then tied, thus permanently closing the chest cavity against recurrence of pneumothorax.

The Sauerbruch Cabinet and Other Methods.

Many other forms of apparatus have been invented during the past few years for the purpose of controlling especially that form of pneumothorax that is produced intentionally during operations upon intrathoracic organs. This idea was brought forward successfully and effectively first by Sauerbruch, who introduced a negative pressure cabinet in which the surgeon and the body of the patient was placed while the patient's head projected into the outer air through an opening lined with a perforated rubber sheet, the perforation fitting snugly about the patient's neck. By pumping air out of the chamber containing the body a sufficient negative difference of pressure could be produced to cause the air which entered the lungs through the trachea at a higher pressure to distend the lungs to a sufficient extent to prevent the formation of pneumothorax when the chest wall was opened. The degree of pressure can be accurately controlled by an assistant.

Brewer produced the same effect by overpressure by leaving the body of the patient in the atmosphere of the operating room and placing the head in a cabinet into which air is being pumped in sufficient quantity to produce a sufficient degree of pressure to prevent the formation of pneumothorax when the chest wall is opened. Robinson has perfected a most excellent apparatus for the same purpose, in which the cabinet containing the high pressure air is sufficiently large to accommodate the anesthetist at the same time. Willy Meyer has produced a still more ingenious apparatus that can be changed from a negative to a positive pressure, and *vice versa*, in a moment.

All of these forms, however, are extremely expensive and complicated and only available in large institutions.

The same overpressure effect has been produced by Fell with an extremely simple mechanism that may be obtained at a very small cost and which has been used in a large number of cases with absolutely satisfactory results. It consists of a compound bellows furnishing a uniform stream of air which is forced into the lungs through an accurately fitting mask applied over nose and mouth, or through an intubation or a tracheotomy tube. Melzer and Carrell have produced the same result by pumping air into the lungs with ordinary bellows through a catheter filling the trachea to two-thirds of its size and extending almost but not quite to the bifurcation of the trachea.

We have seen all of these methods in use but have used only the Fell apparatus in our own practice and its simplicity and effectiveness has impressed us strongly in its favor. Theoretically, however, there seems to be no doubt but that the apparatus of Willy Meyer is at the present time the most perfect for the control of pneumothorax during intrathoracic operations.

The chest wall in all of these cases must of course be definitely closed before the apparatus is discarded after any of these operations.

HYDROTHORAX.

Hydrothorax is so easily recognized by physical examination that it is scarcely worth while to discuss it. It is so common in its occurrence that it rarely reaches the hands of the surgeon. The accumulation of fluid in the pleural cavity may absorb spontaneously or it may be withdrawn by aspiration. Only a part of the fluid should be withdrawn at one time. Many authorities prefer to withdraw but a few ounces and to depend upon absorption for the removal of the remaining portion, which usually occurs after a few ounces have been aspirated. Other surgeons prefer to remove a considerable proportion of the fluid. There is no doubt but that it is wise never to remove the entire amount present.

TUMORS OF THE CHEST.

Of tumors of the chest which are interesting in a surgical way only those due to the presence of hydatids, actinomyces and syphilis, and dermoid cysts, need to be mentioned. Sarcomata, carcinomata and endotheliomata occur but are not interesting surgically (i. e., call for no particularly different form of treatment) except from a diagnostic standpoint. Hydatid cysts most frequently occur through perforation of the diaphragm on account of infection from hydatids of the liver. This condition is treated in the same manner as empyema. Actinomycosis has already been discussed. Gummata are treated by means of internal medication if the condition is recognized. Dermoid cysts are enucleated, the same precautions being taken to prevent collapse of the lung that were described in connection with the treatment of abscess of the lung.

Lympho-sarcomata are of especial interest because their usual location about the diaphragm makes the differentiation between this condition and empyema difficult at times.

MEDIASTINAL ABSCESS.

This affection is recognized by the symptoms of weight and pain in the retro-sternal region. The pain is increased especially upon drinking, coughing, and upon pressure. There is frequently a swelling over the surface of the sternum. The condition is treated, when diagnosed, after the same manner as abscesses in general. An opening is cut in the sternum and the pus permitted to evacuate. The cavity is then drained by means of strands of gauze carried to the bottom of the abscess.

TUBERCULOSIS OF THE STERNUM.

The sternum may be removed in part or entirely for tuberculosis, precisely as one would remove a tuberculous rib. If possible the costal attachment should not be disturbed. The operation is not especially dangerous because there is in these cases a sufficient support on account of the presence of connective tissue which has formed behind the sternum as a result of the long-continued inflammation which preceded the destruction of this bone.

INFECTIONS OF THE MAMMARY GLAND.

Methods of Production.

These occur most commonly through abrasions of the nipple during nursing. The mouth of the child may contain the infectious micro-organisms or they may be upon the surface of the nipple when the child is applied, or fissures may occur and the staphylococci which are ordinarily found in the skin may cause the infection. The arrangement of the lymph channels and milk ducts, and the connective tissue structure of the breast, radiating in every direction from the nipple as a center, account for an infection following one or more of these structures and becoming localized at a smaller or greater distance from the nipple. It may then progress to the formation of abscesses varying in size and location.

Upon examination one or more points of induration are commonly found. The tissues over these points are edematous and there is pain upon pressure. If the infection is advanced there is also redness or fluctuation present. The acuteness of the attack will differentiate this condition from tumors.

Aside from the history of lactation there may also be one of traumatism, or there may be evidences of an infection in some other portion of the body.

Rest and Methods of Prevention.

Early in the occurrence of an infection of the breast it is frequently possible to cause it to subside by securing absolute rest. The blood supply of this portion of the body is so plentiful that an extensive amount of infectious material may be entirely absorbed if the progress of the infection is not favored by motion. The patient should therefore be placed in bed and the breast supported by strapping, preferably with rubber adhesive straps that have been carefully applied, or with an accurately applied flannel or elastic rubber bandage. If the infection is quite slight then a large, moist, antiseptic dressing covered with rubber protective tissue will probably best favor absorption, the patient of course being kept at rest. Further infection should be prevented by thoroughly washing the nipples before and after each nursing and by applying some antiseptic substance, such as ointment containing boric acid or some substance like tincture of benzoin or tincture of myrrh, which has a protective effect on account of its resinous character. Solutions of rubber have been prepared which may be applied to the nipple after it has been carefully dried, and which will serve as an excellent protective covering. Above all things the nipples should be kept clean at all times and should be carefully washed just before and just after nursing. The child's mouth should also be washed in order to prevent infection from this source. The milk should be pumped out of such a breast at regular intervals, care being taken not to cause any traumatism of the infected tissues by the manipulations which are thus necessitated.

Technique.

If the infection progresses to the formation of circumscribed abscesses these should be incised freely and drained by the insertion of gauze or gutta percha tissue drains and a sufficiently large dressing should be applied to absorb all of the discharge. Personally, we prefer a moist antiseptic dressing consisting of one part of alcohol with two parts of saturated solution of boric acid for this purpose.

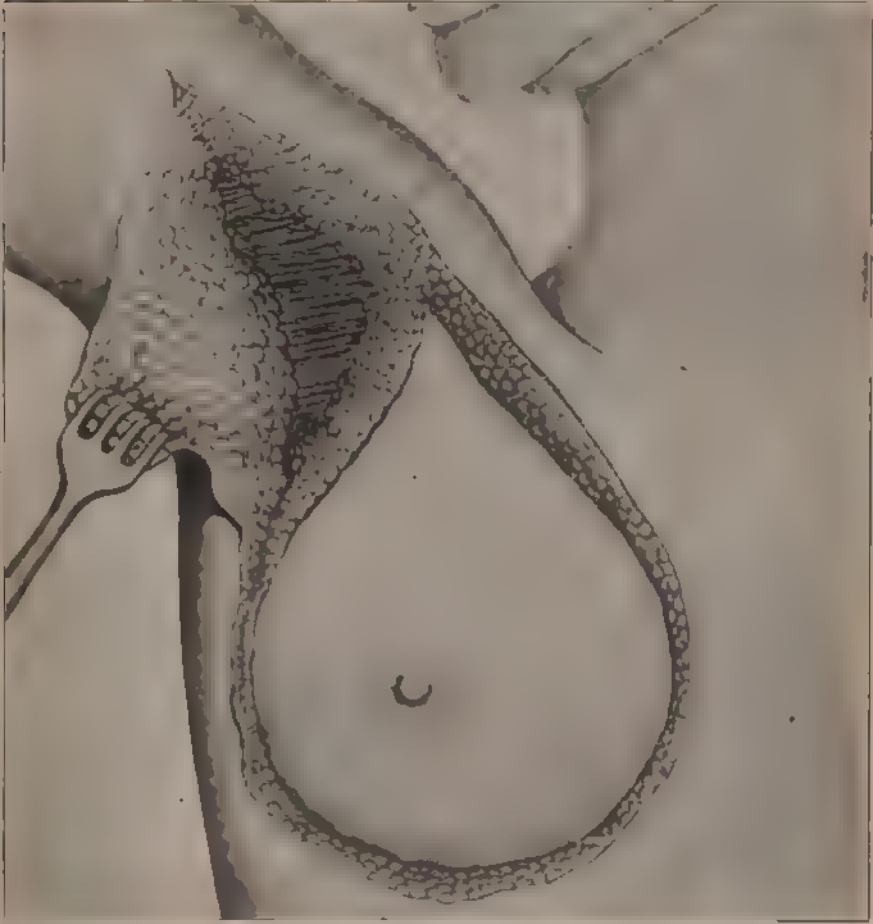


PLATE IV

AXILLARY REGION OF BREAST

The incision extends in front of the axillary space and includes a considerable amount of skin overlying the mammary gland

It is important that the incisions should be made in a manner so as to cause them to radiate from the nipple in order to prevent cutting off any of the ducts which branch from this point. Rest in bed and support by means of dressings and bandages should be insisted upon, because this will prevent any formation of further abscesses by progressive infection after the primary focus has once been opened.

CHRONIC MASTITIS.

Chronic Mastitis is the result of a deep-seated infection with pus microbes of moderate virulence. This condition may give rise to the diagnosis of tumor of the breast.

The application of a large glass bell attached to an air-pump, according to Bier's method, once each day over a breast which has been incised for the relief of abscess greatly facilitates the patient's recovery. The negative pressure must, of course, be carefully regulated to prevent unnecessary pain.

In protracted cases that come under the care of a surgeon a long time after the abscess has been lanced, so that only a sinus is left, we have had satisfactory results by applying Bier's vacuum pump and later injecting the sinus with Beck's bismuth paste.

TUMORS OF THE BREAST.

Dangers of Even Simple Growths.

The most common benign tumor in the breast is the fibro-adenoma. Pure fibromata and pure adenomata are exceedingly rare. Aside from these are found retention cysts, lipomata, enchondromata, and, very rarely, hydatid cysts. All of these tumors are likely to occur in young patients. They are movable and are not accompanied with retraction of the nipple. They give rise to no pain and rarely grow to any considerable size. We have, however, observed a large number of cases in which such tumors remained perfectly harmless until the patient's age exceeded forty years, when the condition changed, at first usually so slowly that the patient hardly was aware of the alterations, then definite, stinging pains were felt and later a slight degree of induration. The history would then show that when the patient came under observation it was plain from the external examination that we had to do at best with an adeno-carcinoma, although in these cases of long standing there could be no doubt but that they had started as perfectly benign growths. We have encountered many of these which were hopelessly advanced inoperable carcinomata when they came.

Accepting the general statement that there is a tendency in all tumors of the breast, with the exception of lipomata, to become malignant later in life, it consequently seems wise to remove every benign tumor in this location as early as possible after it has been discovered. The operation is safe, does not inconvenience the patient, and may relieve her of a very serious danger. The incision should be made as much as possible in the direction indicated in the previous operation.

Carcinomata are the most common of all malignant tumors of the breast. Epitheliomata are less frequent; sarcomata still less frequent in their occurrence. Paget's nipple, which is a dermatitis with a tendency to the development of epithelioma, is not very common in this country.

Physical Signs.

Heredity is supposed to be an important element in the history of

malignant tumors of the breast. The growth itself may have existed in the form of a benign tumor for a considerable period of time (as has just been pointed out), or it may appear in the form in which it persists. Its location is more commonly directly underneath the nipple, but it may occur in any portion of the breast. At first it is movable, but later it becomes adherent to the skin or to the fascia of the pectoralis major muscle. One of the signs which has been recognized as characteristic is the *retraction of the nipple* due to the contraction of the underlying trabeculae of the connective tissue. This condition, however, is present only if the tumor is near the nipple. If the growth is slow the tumor is hard; if it is rapid it may be either soft or hard upon pressure.

Sooner or later the disease progresses along the lymph channels, forming secondary nodules in the lymph glands, first in the axillary region, second, in the infra-clavicular and later in the supra-clavicular region. Still later, lymph channels extending toward the skin are invaded and the latter is presently destroyed, giving rise to an open ulcer.

A Dangerous Custom.

At this point we wish to state emphatically that observations have convinced us that an enormous amount of harm is done to patients suffering from incipient carcinoma of the breast by the careless manipulation of this organ by the physician or surgeon making the examination, or by any other persons handling the part. We believe that many times we have seen the growth of carcinoma of the breast largely increased in this manner. We believe also that we have observed cases in which secondary infection of the lymphatics, and even of the liver, was caused by frequent manipulation. During the past few years we have encountered a number of patients suffering from this disease who were treated by severe massage at the hands of osteopathic healers, in whom there was an enormous increase in the growth of the tumor in a relatively short time, and in several cases a secondary infection of the liver. In the same manner an infection with carcinoma may extend into the chest, following the lymphatics which accompany the internal mammary artery; or the opposite breast may be invaded because of the lymphatic connection between the two organs; or it may extend along the intercostal lymphatics into the spine, giving rise to paraplegia dolorosa.

If there is any doubt as regards the diagnosis of carcinoma of the breast we believe that in every case it is much better for the patient to have the organ removed at once, and with the same care that would be exercised if its malignancy were positively known, rather than to temporize until the condition becomes so plain that the surgical treatment is usually useless and the patient therefore in a hopeless state.

Age Incidence.

Carcinoma containing an abundance of connective tissue is more likely to occur in those advanced in years and the malignancy of this form is not so great as that in carcinoma with but a slight amount of connective tissue. The latter form of carcinoma is more likely to occur in young persons, usually under fourteen years of age. Sarcoma is also more prone to occur at this age, while epithelioma, starting in the skin and penetrating the deeper tissues, is more apt to develop in patients over forty years of age; *but it is not safe to depend upon the age in making a differential diagnosis between benign and malignant tumors of the breast.*

To differentiate between chronic mastitis and tumors, it will be found

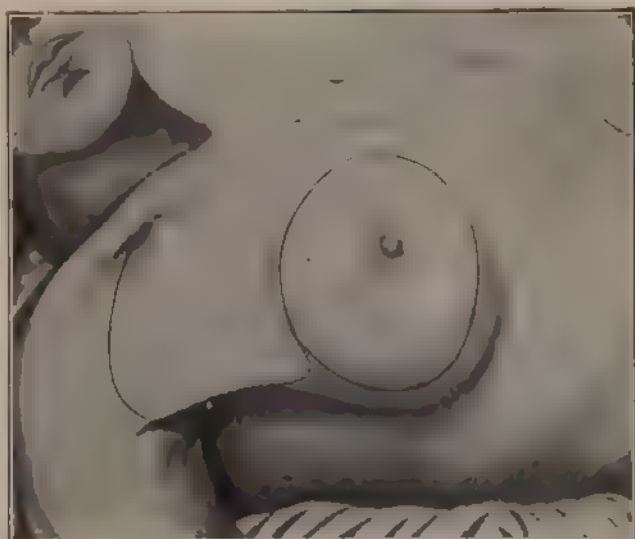


PLATE V.
Outline of Incision, Marked with a Scratch Stroke of the Knife
(Jabez Jackson)



PLATE VI
Exposure and Division of the Pectoralis Major
(Jabez Jackson)



PLATE VII.
Isolation and Division of the Pectoralis Major. (Jabez Jackson.)



PLATE VIII

Pectoralis Muscle Severed from Beneath, and Perforating Branch of the Internal
Mammary Caught with Forceps (Jabez Jackson)



PLATE IX

Method of Insertion of Figure-of-eight Coaptation Sutures (Jabez Jackson)



PLATE X

Flap Sutured in Place, with Drainage Tube Inserted (Jabez Jackson)

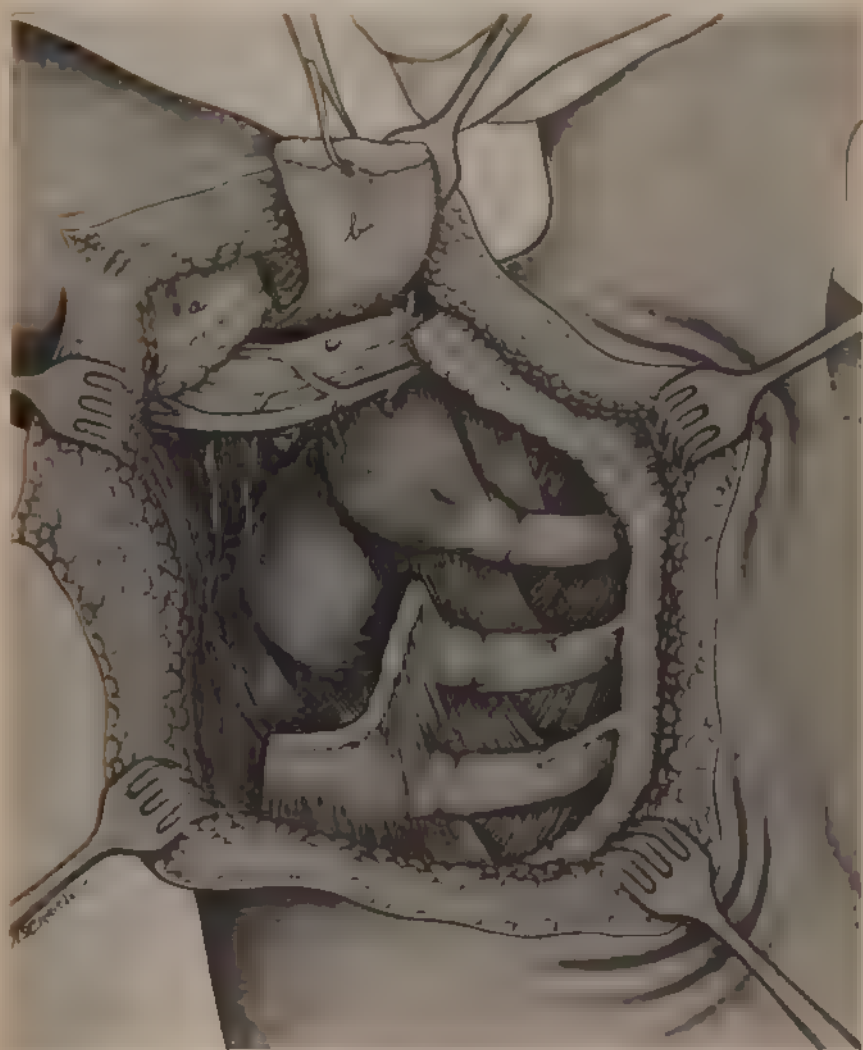


PLATE XI

AMPUTATION OF BREAST FOR CARCINOMA.

a cut end of pectoralis major muscle, b cut end of pectoralis minor muscle,
c brachial plexus of nerves; e axillary vein



PLATE XII.

AMPUTATION OF BREAST FOR CARCINOMA

The wound has been sutured and drainage tubes are in place

that when the breast is pressed against the chest wall with the hand in mastitis the enlargement is of uniform consistency, in tumors there is a nodular arrangement of the thickening.

Operative Principles.

There are a few important principles which should be remembered in the removal of a carcinoma of the breast:

1st. The direction in which carcinomatous infection progresses from the primary seat of disease, and consequently the direction in which recurrence is likely to take place, should be noted. Bearing this in mind, it is important to remove a large portion of skin overlying the tumor, as shown in Plate IV, even though the tumor itself be quite small.

2nd. The subcutaneous fat should be removed for a great distance.

3rd. All the tissues to be removed should be included in a continuous mass to prevent the infection of any portion, during the progress of the operation, from an exposed part of the malignant growth.

4th. All the soft tissues down to the ribs, to a point up under the clavicle, as far as possible into the axilla, including the overlying skin, the superficial and deep fascia, the fat, the entire breast enclosed in its capsule, the pectoralis major and minor muscles, and all the axillary and subclavian fat, together with the lymphatic glands contained in it, should be removed in one mass.

5th. The patient must be protected against too great a loss of blood.

6th. The important subclavian and axillary vessels and the pleura must not be injured.

Lines of Incision and Technique.

Many incisions have been planned and for each certain advantages are claimed. It is probably of little importance which is chosen. A very good exposure may be obtained by making a curved wound beginning at a point four inches below the axilla along the anterior surface of the deltoid muscle, extending across the chest at a sufficient distance from the tumor to insure safety against infection, usually a distance of six to ten centimeters from the nipple will suffice, then carrying this incision around the breast at a uniform distance from the nipple and extending upwards to the original point, as shown in Plate IV. The most satisfactory incision for the removal of extensive carcinomata in our experience is the one introduced by Jabez Jackson, as shown in Plate V, because it secures at once the complete removal of all the infected skin, secures a free approach to the diseased tissue as shown in Plates VI, VII and VIII, and provides for the perfect closure of the wound as shown in Plates IX and X.

After grasping the bleeding vessels with pressure forceps the skin around the edge of this incision should be dissected up, the underlying fat being left attached to the chest wall. This dissection should be carried a sufficient distance back to include all the diseased tissue, at least five centimeters in each direction in ordinary cases. The incision is then carried down to the ribs along the border of this area and the entire mass, as described before, is dissected up to a point approaching the axillary vein, care being always taken to grasp the bleeding vessels with pressure forceps. Then the attachment of the pectoralis major to the humerus is severed and, later, the upper attachment of the pectoralis minor is also divided. Between these two attachments it is wise to grasp the vessels with two pairs of forceps, to cut between these and to ligate the stump toward the axillary

side. The distal ends of the subclavian and axillary veins are now dissected free, all the small branches issuing from the veins being caught in two pairs of hemostatic forceps. Cut between, and ligate the end toward the axillary vein close for fear of tearing the latter with the forceps. By proceeding slowly with this portion of the work it is possible in a comparatively short time to lay bare the entire vein without doing any harm to this structure. The dissection is then carried downward through the axillary space, and the entire mass cut away from its posterior attachment, the bleeding points having been caught carefully during each step of the operation so that the entire amount of blood lost will be slight.

It is important that the tumor be not manipulated roughly because it seems likely that carcinomatous cells could be loosened from the substance of the growth if careless handling or pressure be allowed.

If there still remain small portions of fat attached to the axillary structures they can be removed with great rapidity and perfect safety by grasping them in a piece of moist gauze held in the hand and drawing this gauze over these structures, permitting them to slip through the grasp of the hand holding the gauze. In this manner these small portions of fat containing minute lymphatic glands may be removed more perfectly and with much greater ease and rapidity than by actual dissection. All the bleeding vessels that have been caught, from which bleeding has not been stopped permanently by the pressure of the hemostatic forceps, should be ligated. Personally we make use of fine catgut for this purpose.

The area exposed is so enormous that a certain amount of serous discharge must be expected, and consequently we believe it is wise to insert one or two moderate-sized drainage tubes through an opening in the posterior flap, as shown in Plate XII. The wound is then united by means of interrupted tension sutures, for which silk or silk-worm gut may be employed, and coaptation sutures for the purpose of adjusting the edges of the wound. If these edges cannot be adjusted without applying a great amount of tension it is much better to leave a space between the edges of the wound and to cover this by means of Thiersch's skin grafts.

A large dressing is applied to the breast in order to approximate the skin flaps to the chest wall by means of gentle pressure. The arm, to the elbow, is included in the bandage, but should not be tied down sufficiently firm to make the patient uncomfortable.

DISSEMINATED LENTICULATE CARCINOMA OF THE SKIN OF THE BREAST. (CANCER EN CUIRASSE.)

This form occurs not infrequently as a direct cancerous infection of the lymphatics of the skin after an operation for the removal of primary carcinoma of the breast. The infection may also occur directly from the primary carcinoma.

The French name, indicating the appearance of a coat of mail, is so characteristic that one can scarcely fail in making the diagnosis. Near the region of this complication the skin is thickly studded with nodules, usually red in color, and radiating from this area to a considerable distance will be found smaller lenticular nodules. A few times we have observed this form of secondary carcinoma originating in the stitch mark, indicating that the carcinomatous tissue was directly inoculated in the skin from the deeper portions. It is likely that the subcutaneous fat contained the carcinoma cells

in these instances and that these cells were carried by the needle into the overlying lymphatics of the skin proper.

The surgical treatment must be entirely prophylactic. By removing a large portion of the overlying skin, together with the carcinoma of the breast, it is likely that this complication will be prevented.

During the past few years a number of these apparently hopeless cases have recovered after the use of the Roentgen rays. Whether such recovery is to be permanent or temporary remains to be seen. In our own experience no patient has ever presented herself for treatment of this condition to whom we could promise any surgical relief. Whether the excision of a large portion of skin and underlying fat would give relief in cases coming under treatment very early we are unable to state.

EPITHELIOMA OF THE BREAST.

Primary epithelioma of the nipple is not very uncommon. Its progress is likely to occur more rapidly into the deep structures than into the surrounding skin. Even at a very early stage there has usually been a secondary infection of the tissues of the breast itself. In a few instances in which the disease seemed to be very limited we have found that there was an infection not only of the tissues of the breast, but also of the axillary lymphatic glands.

The conditions just described will of course indicate that the same plan of treatment must be followed which has been outlined in connection with carcinoma of the breast proper. If anything less is done the progress of the disease will only be increased and the patient is likely to succumb sooner than she would if nothing at all were done in a surgical way; in fact, with a thorough removal of the skin, the breast, the pectoralis major and minor muscles and the axillary and subclavian lymphatics and fat, these patients have a chance to recover permanently.

SARCOMA OF THE BREAST.

The diagnosis of sarcoma of the breast can usually not be made positively until the tumor has been removed. This is of little importance inasmuch as the same operation must be performed which would be done in the presence of a carcinoma.

TUBERCULOSIS OF THE BREAST.

Patients suffering from tuberculosis of the breast usually give a history of tuberculosis in some other portion of the body, most commonly pulmonary.

In many cases there is the history of an injury; in others the history of localized tuberculosis of the lymph glands in other portions of the body. The history, together with the general appearance, of the patient and the fact that the axillary glands are usually enlarged, while the examination of the breast itself gives the impression one obtains in manipulating a chronic mastitis or a multiple fibro-adenoma, usually suffices to make a fairly positive diagnosis of tuberculosis. There are, however, cases in which it is not possible to differentiate this condition from carcinoma. If the disease has existed for a more or less extended period of time some portion of the growth will have usually undergone caseous degeneration, giving rise to

the sensation of fluctuation, which will also serve as a diagnostic sign. The nipple is usually retracted.

The treatment should consist in the removal of the entire breast, together with the lymphatic glands and fat of the axilla. It is not necessary here to disturb the pectoralis major or minor, or the fascia covering the former. Unless there is present a mixed infection of some broken down portion of the tumor it is usually safe to close the entire wound without drainage.

MILK FISTULA.

Following an incision into the breast for the drainage of an abscess, or following the spontaneous opening of an abscess of the breast, and occasionally following traumatism, a fistula remains connected with one of the milk ducts which secretes milk either constantly or intermittently.

In recent cases these fistulæ can sometimes be cured by cauterizing the external opening, or by curetting the fistula, or by making a longitudinal incision through the fistula, but in chronic cases a careful excision of the false passage is necessary in order to secure permanent relief.

MOBILIZING THE CHEST WALL FOR RELIEF OF PERICARDIAL ADHESIONS.

Pericardial adhesions to the chest wall cause a condition which is at once most distressing to the patient and exhausting to the heart itself, as with each contraction the heart makes an unsuccessful effort to pull itself away from its fibrous attachment to the chest wall, and with each expansion it is pushed by the adhesion against this rigid wall.

Mobilizing this rigid wall then over the area occupied by the heart must necessarily bring great comfort to the patient and must at the same time reduce greatly the wear and tear upon the heart itself. This may be accomplished by the following operation:

Technique.

A curved incision is made just below the left mammary gland from fifteen to twenty cm. long; the breast is reflected upward and the fourth, fifth and sixth ribs are laid bare. The middle of the area to which the pericardium is adherent is determined by the impact of the heart and each rib is excised to the length of twelve cm. so that a vertical line drawn through the center of the area of impact would bisect each fragment of rib removed.

In making this excision if possible all of the periosteum should be removed with the ribs, so as to prevent their regeneration.

The skin and muscle flap is then replaced, two small gutta percha tissue or fine rubber tube drains are inserted, and the wound is closed.

The relief is almost instantaneous because the soft wall which takes the place of the rigid costal wall yields readily with the motion of the heart, whose pulsation consequently becomes slower with an improved character and quality of the contraction, and a rapid building up of the patient's general condition.

PERICARDIAL EFFUSION.

While this can hardly be classed as a surgical disease, yet the surgeon

is often called upon for relief when it has become distressing, and so it may be proper to contribute a few words to the subject at this point.

The heart is usually sufficiently far away from the chest wall, because of the presence of a large amount of pericardial fluid, to prevent injury when the trocar is inserted for the purpose of partial withdrawal of fluid.

The puncture should be made in the fifth or sixth intercostal space in the left mammillary line in large accumulations, which are the only ones that require this operation.

It is best to use a trocar two mm. thick with a very sharp but short pointed stillette. The distance to which this is to be plunged into the chest must be determined by holding the point of the index finger against the trocar so that it cannot be forced in any farther than contemplated. The stillette is then withdrawn and enough fluid is permitted to escape to give immediate relief, but not enough to shock the patient or to permit the heart to touch the pericardium.

The fluid should be withdrawn very slowly, with repeated interruptions, especially if there is any irregularity in breathing or in the heart's action during the progress of the operation.

The canula should be held in such a direction that there is no danger of the surface of the heart striking against it and becoming lacerated. The withdrawal of a portion of the fluid, usually from one to four ounces, is likely to stimulate absorption of the remaining portion, but if this does not occur the operation must be repeated whenever a sufficient amount has re-accumulated to give rise to much distress.

In introducing the trocar the intercostal vessels should be avoided by remaining near the upper margin of the rib, below the puncture point, and avoiding the lower edge of the upper rib. The fourth, fifth or sixth intercostal space should be chosen, according to the position of the fluid.

PERICARDIAL SUPPURATION.

The condition just described may be followed by suppuration in the pericardial space. In this event it seems reasonable to expect that the two per cent formaline in glycerine treatment introduced by Murphy for the cure of empyema of the chest should give satisfactory results.

We have not yet had an opportunity to test this method.

Simple aspiration without free drainage has given such absolutely unsatisfactory results that this should never be practised, and in case of diagnosis of pericardial effusion and demonstration of the presence of pericardial suppuration upon aspiration the radical operation should be done at once.

The operation for the relief of this condition consists in the removal of ten cm. of the fourth or fifth rib over the most prominent portion of the pus sac, placing gauze into this wound for 24 to 48 hours and then making a crucial incision through the middle of the exposed area the pus is permitted to drain through a pledget of gauze or one composed of folded rubber tissue.

We have not had an opportunity to use Beck's bismuth paste in these cases in the after-treatment, but it seems plainly indicated where healing does not take place promptly after drainage has been installed.

In cases wherever the intercostal tissues are edematous at the time of the operation it is not necessary to postpone the incision if the patient's con-

dition is such as to make an immediate evacuation of the pus desirable, because there is no danger in these cases from the occurrence of hydrothorax, owing to the fact that the existing inflammatory process has produced the necessary adhesions to prevent this.

WOUNDS OF THE HEART.

It is important to be familiar with some method of exposing the heart in case one should encounter a patient suffering from a stab or gunshot wound thereof. We have never had an opportunity to operate in one of these cases and consequently cannot speak from personal experience with any method, but the subject is so important and any surgeon is so likely to be in a position in which he must act promptly, that we will give the method advocated by Kocher because it has the advantage of great simplicity and at the same time fills all of the demands met by any or all of the many more complicated methods. It secures an easy, rapid approach to the heart, gives an excellent exposure of the organ and guards against the formation of pneumothorax.

In hospital practice this should further be guarded against by the use of one of the various devices that have already been described; but most of these patients are so seriously injured that the time necessary to adjust an apparatus would probably be sufficient to permit the patient to die from hemorrhage unless the Fell or the Melzer type happened to be available.

The entire chest should be quickly saturated with compound tincture of iodine, which should always be at hand. The surgeon should put on sterile rubber gloves without stopping to scrub his hands.

If no tincture of iodine is available the skin should be scrubbed rapidly with warm water and soap with a piece of gauze, then with alcohol, then ether.

An incision ten cm. long is made from the middle of the sternum over the sixth costal cartilage to the bony part of the sixth rib, cutting the attachment of the rectus abdominis muscle. The pectoralis major is loosened from its attachment to the upper border of the rib and the attachment of the intercostal muscles is loosened both above and below with the knife. The perichondrium on the posterior surface is loosened with a periosteal elevator. The sixth costal cartilage is now cut at the point of its attachment to the sternum and that to the seventh costal cartilage.

The internal mammary artery and vein are seen at a point one cm. to the left of the sternum; they are clamped, cut and ligated.

Underneath this point the sternal attachment of the transverse thoracic muscle is cut, and the muscle, together with the pleura, is pushed to the left, which exposes the dense fibrous pericardium.

If the heart is compressed by the accumulation of blood in the pericardium this sac is opened at once, otherwise the following steps are taken:

If the wound is in the upper portion of the heart the incision is carried upward to the fourth, third or second intercostal space. Here a lateral incision is made eight cm. long through the pectoralis major muscle to the upper margin of the costal cartilage and rib. The intercostal muscle is loosened from its attachment to the upper margin of this cartilage and rib. The pleura, together with the transverse thoracic muscle, is now separated from the cartilages and ribs and shoved to the left and a sufficient amount of the ribs, together with the cartilages, is cut away to provide the necessary

space for the completion of the operation, which exposes the heart from apex to base. In case of injury to the pleura the opening is at once caught with clamps and later ligated or sutured with catgut.

It is not always necessary to make so complete an exposure of the heart because the wound may present itself at a point where the heart is first observed. In this case it is of course only necessary to close the wound at once and the operation can be completed without making so extensive a wound. On the other hand even this extensive exposure may not be sufficient when the right ventricle has been injured, in which case it is best to cut off the sternum transversely with bone-cutting forceps and turn it out of the way to the right. But it is only rarely necessary to make so complete an exposure of the heart.

The heart is grasped with two fingers of the left hand and the first suture inserted one cm. beyond one end of the wound. The end of the suture is left long and held by means of hemostatic forceps to facilitate the completion of a continuous suture. Fine silk or fine very reliable chromicized catgut should be used for suturing a heart wound.

The pericardium and the pleura are sutured with catgut at once without drainage. The flap is then replaced and sutured and two small drains inserted to prevent accumulation of serum from the large wound surface.

It is important to perform the entire operation with the very greatest precautions against infection, for this is practically certain to destroy the life of the patient in even the most hopeful cases if it occurs.

Transfusion of normal salt solution is indicated after the operation; and if possible transfusion of human blood by the method introduced by Crile would undoubtedly be beneficial.

EXCISION OF COSTAL CARTILAGES FOR RELIEF OF EMPHYSEMA.

This operation has been strongly recommended because it reduces the size of the chest and thus permits the emphysematous portions of the lung to contract. We have not done this operation for this particular purpose and cannot therefore speak authoritatively concerning its beneficial effects, which, however, seem reasonable. The same operation we have performed frequently for the removal of diseased cartilages. It is simple and with reasonable care it is perfectly safe.

An incision is made along one border of the sternum, from five to seven cm. from its center, and extending from the clavicle to the lower border of the ribs. The soft tissues are reflected inward and outward and each cartilage is exposed successively. With a sharp, heavy cartilage knife the cartilages are cut off successively, then each cut end is elevated with a curved periostome and from one-half to three cm. of the cartilage is removed, the shorter excision being made at the upper ribs. The wound is then closed and dressed and a circular bandage of wide rubber adhesive strips, extending entirely around the chest, is applied the same as in the treatment of gunshot or stab wounds of the chest. The other side is treated in the same manner as soon as the patient's condition warrants a second operation, which should, however, not be performed too soon.

FOREIGN BODIES LODGED IN THE BRONCHI.

The most common foreign bodies encountered in the bronchi are small

objects which children hold in their mouths while playing, like kernels of corn, peanuts, beans, tacks, pins, parts of playthings, etc.

If these are of metal or any other substance that will throw a shadow when the chest is exposed to the X-ray, so as to be seen through a fluoroscope, the object can sometimes be grasped with proper forceps and removed under guidance of the X-ray shadow.

Light objects like kernels of corn, beans, small buttons, etc., will usually be coughed out of the tracheotomy opening, if tracheotomy is performed with a dependent head, the patient being placed in the Trendelenburg position with the foot of the table elevated to about forty-five degrees.

Of course this will occur only if the object is not impacted, or has not been fastened by the occurrence of edema. If the object has become fixed its location may usually be determined by auscultation, as no air passes beyond the location of the foreign body. In these cases a low tracheotomy should be made and a forceps should be carried down the trachea into the bronchus and down the bronchus until it touches the foreign substance, then the jaws of the instrument should be opened and the object grasped if possible.

At the present time it is, however, scarcely proper for any one without special training to undertake this operation. It is better to have the patient examined with the bronchoscope and the attempt at removal made by an expert.

So long as the object is in the trachea its removal, if this does not occur spontaneously upon opening the trachea, can be accomplished by any surgeon with ordinary skill and experience, while if it has passed beyond the bifurcation of the trachea then one side of the lungs is free and there is no danger of the patient losing his life from asphyxiation; at the same time the removal of the foreign body becomes thus very much more difficult, and hence there are two very good reasons why the patient should be taken to an expert.

At times parents are not certain as to whether a foreign body has actually been inspired. In these instances the patient frequently does not reach the care of a surgeon until the body has ulcerated through the wall of the bronchus and into the lung, giving rise to the formation of an abscess of the lung. In these cases skiagrams should be made both from an antero-posterior, and from a lateral view, in order to locate the object as nearly as possible.

The treatment indicated is that advised for abscess of the lung from any cause. These operations should be performed in the pneumatic cabinet, or with the help of the Fell bellows, because in this way the danger from pneumothorax can be avoided, the operation performed with much less hurry and the risk reduced to a minimum.

PART V.

GENERAL SURGERY OF THE ABDOMEN.

There are a few conditions connected with abdominal surgery which may be considered in a general way as they apply to all operations in which the abdominal cavity is opened.

Preparatory Treatment.

In performing intra-abdominal operations the matter of space is of great importance, because an abundance of room facilitates the operation to a marked degree.

It is astonishing how much space may be gained by securing an empty condition of the stomach and intestines. If these are filled with food, gas and residue, the simplest operation may be quite difficult, while it will be many times less troublesome if the intestines are as empty as possible. Moreover, the proximity to the seat of operation of decomposing intestinal contents is not to be desired. With only the thickness of the intestinal wall between the wound and this material the patient is not nearly so safe as he would be were the alimentary canal empty.

Cathartics.

No other cathartic has accomplished this condition so thoroughly, in our experience, as castor oil, given in the foam of beer or malt extract on the day preceding the operation. We have found that two ounces is the most satisfactory dose. If given in this manner it rarely nauseates the patient, it causes very little or no pain, and it is certainly effective in almost every case, leaving the intestines free from gas and feces. It is well to give only sterilized food for twenty-four hours previous to the operation, preferably sterilized milk or broths.

Diuretics.

After many intra-abdominal operations there seems to be an interference with the functional activity of the kidneys, rather more marked than in any other operations not performed directly upon the kidneys or urinary tracts. It is consequently wise to encourage their activity on the day before the operation by giving pure water, preferably hot, in considerable quantities.

The hot bath which has been mentioned in connection with the preparation of patients for operation in general is especially useful in these patients, because it stimulates the process of elimination through the skin as well as through the kidneys. In case there should be a lack of excretion of urine this can usually be induced by administering an enema of one-half pint of normal salt solution every hour until the condition is relieved. To these enemata from 10 to 25 grains of acetate of soda may be added until there is

a free flow of urine. The same result may be accomplished in an admirable manner by the continuous proctoclysis introduced by Murphy and described elsewhere herein, normal salt solution being employed in this as in other cases. In cases in which this does not bring satisfactory results 1,000 cc. of normal salt solution may be injected subcutaneously before and after the operation.

Abdominal Incisions.

In making an incision through the abdominal wall, the anatomical layers composing this wall should be considered, for if they are not the closure of the cavity after the intra-abdominal operation has been completed may not be satisfactory and may result in a weakened point in the wall which may presently develop into a hernia, and this may be a many times more serious affliction to the patient than the condition for which the operation was originally undertaken.

Plate XIII shows the arrangement of the layers of the abdominal muscles, together with the location and direction of the usual incisions through the abdominal wall in the median line and on the right. Of course, the same relative positions would be suitable on the left side, although on account of the location of the gall bladder and the vermiform appendix on the right side, many more abdominal sections are made through this than through the left abdominal wall.

The incision marked *a* is suitable for all operations upon intra-abdominal organs located in the pelvis. In cases of chronic appendicitis the vermiform appendix can also be removed through this incision.

The incision marked *b* is suitable in cases in which the vermiform appendix and the right ovary and tube are implicated; *d* indicates the incision known as McBurney's, for the removal of the appendix; *c* is favorable for operations upon the gall bladder, and the appendix can usually also be removed through this incision; *e* offers the same advantages in the hypochondriac region that *d* gives in the iliac region; *f* furnishes an approach to the stomach; although we more frequently use incision *c* for this purpose, because, through this incision we can more conveniently inspect the gall bladder, duodenum and appendix.

In *a* and *f* the incision is made through the linea alba between the recti muscles; *b* and *c* split the fibers of the recti muscle, and *e* and *d* split the fibers of the external oblique, then the edges of this muscle are retracted and then the fibers of the internal oblique are separated, the incision extending at right angles to the fibers of the external oblique. The incision is then extended through the fibers of the transversalis fascia and the peritoneum.

In all of these incisions none of the abdominal muscles is cut at right angles, which is of the greatest importance, for were they cut at right angles their ends would be retracted, and the more the muscles contract obviously the more the wound shows a tendency to gape. In closing a wound in the abdominal walls in which some of the muscles have been cut at right angles, it is often impossible to secure a satisfactory union between the cut ends of the muscle.

The conditions are entirely different if the muscle fibers have only been split according to the scheme indicated in Plate XIII as the natural contraction of these muscles has a tendency to bring their edges close together and to cause a spontaneous closure of the abdominal wound in this manner.

Each one of these incisions will be carefully described and illustrated in connection with cases in which it is to be employed.

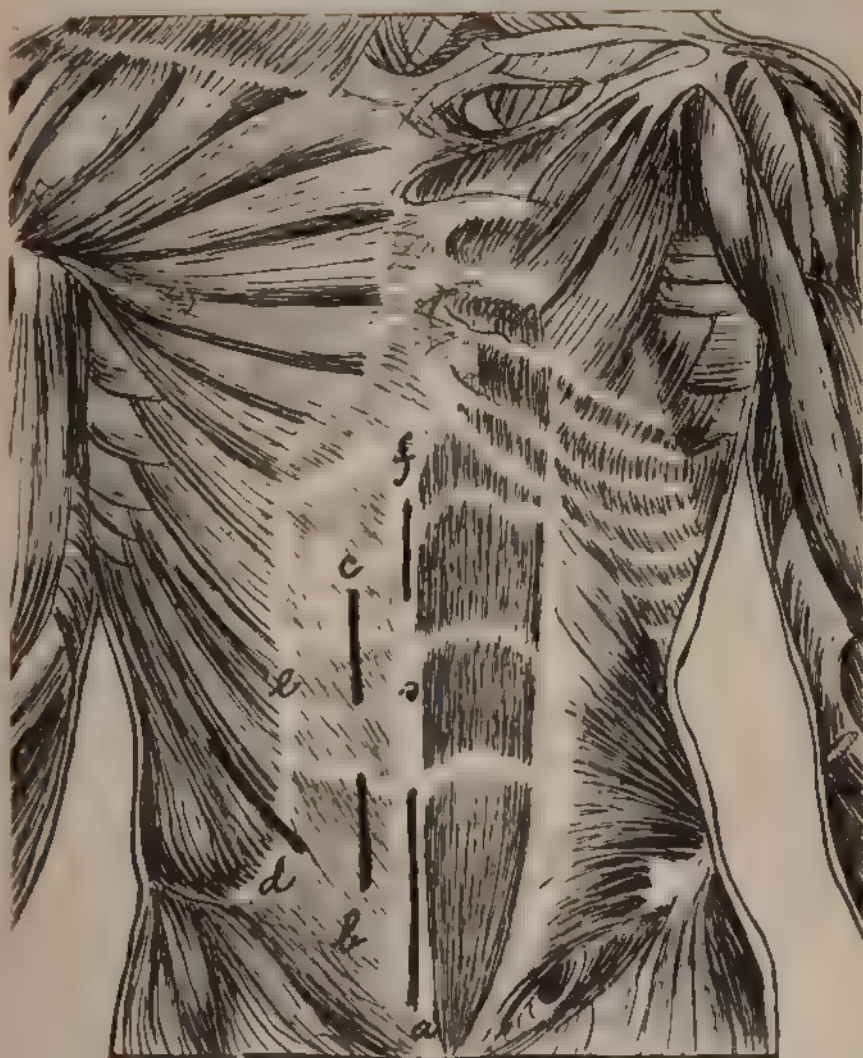


PLATE XIII.

LOCATION OF ABDOMINAL INCISIONS.

Represents the abdominal muscles with the various lines of incisions indicated on the right side; the same incisions may of course be practised on both sides of the abdomen, but the location of the vermiform appendix and the gall bladder makes these incisions more common on the right side. On the left side the external oblique abdominal muscle has been removed, showing the rectus abdominis and the internal oblique. (a) represents the incision through the linea alba below (f) above the umbilicus. (b) through the outer edge of the right rectus abdominis muscle below, (c) above. (d) McBurney's incision. (e) the same incision over the kidney.

These incisions may, of course, be changed as regards their distance from the median line, their length and their position upon the abdomen, so long as their direction corresponds with that of the muscles of the abdominal wall.

In order to make the position of these incisions more clear, they are shown in Plate XIV upon the surface of the body, without indicating the direction of the underlying muscles, using the same letters as in Plate XIII for the various incisions.

Traumatism.

In no field of surgery is it more important to avoid unnecessary traumatism than in the abdomen. This can be accomplished by eliminating from the field of operation the portions not implicated in the disease by tamponing them away with large pads of soft, aseptic gauze, moistened with warm, normal salt solution. These pads should be applied carefully and gently, in order not to cause any traumatism, and left in place until the operation upon the diseased portion has been completed.

None of the intra-abdominal tissues not implicated in the disease should be manipulated during the operation, in order to avoid unnecessary shock and possible infection and consequent adhesions. Manipulation in inflamed or congested intra-abdominal organs is especially likely to give rise to shock, and in these cases it is consequently even more important to limit the manipulations as much as possible. So long as the peritoneal surface has not become abraded the likelihood of infection is very greatly reduced, and the less these organs and tissues are manipulated the less likely are they to suffer the abrasion of their peritoneal surfaces.

Gaseous Distension.

Much of the discomfort following abdominal sections results from gaseous distension of the intestines. This can be reduced to a very marked extent if the alimentary canal has been thoroughly emptied before the operation and if no food be given by mouth for a day or two after the operation.

The patient may be supported very well by the administration of one of the numerous predigested foods in the market given by enema. One ounce of this is given in three ounces of normal salt solution every three to four hours. Or if this is not convenient, a simple enema of eight to sixteen ounces of normal salt solution given every three to four hours seems to relieve the sense of hunger.

Both hunger and thirst after operation are relieved by the use of continuous normal salt solution proctoclysis. It is usually best to give this for two hours continuously, then to interrupt it for two hours or until the patient becomes thirsty, and then to repeat. This also is an excellent means for preventing shock.

The amount of pain suffered after an intra-abdominal operation is also greatly reduced if no food be given by mouth. In case, however, there should still be a considerable amount of pain, this may be relieved safely by the use of morphia hypodermically. This is not safe when food has been administered, because the relaxing influence of morphia upon the intestinal walls will have a tendency to increase the gaseous distension and the consequent absorption of products of decomposition. We wish to emphasize this point most vigorously, because nothing can be more harmful after abdominal operations than the use of opium or morphia in any manner if some form of

nourishment is given by mouth at the same time; while in cases in which the canal has been thoroughly emptied before the operation by the use of four tablespoonfuls of castor oil these remedies may be employed in reasonable amounts with great benefit to the patient and entirely without danger.

It is this tendency to decomposition, in place of digestion of food given by mouth shortly after an operation, which makes it virtually of no use to the patient, because he obtains no nourishment from the food so taken, while the absorption of the products of decomposition is a real injury. There is, of course, the further advantage in this feature of the after-treatment that it secures a condition of rest for the tissues which have been subjected to traumatism, which in itself is of very great importance.

APPENDICITIS.

In the consideration of this subject we will take a number of cases which have come under care and follow them through the various stages of their disease, precisely as they progressed, which will doubtless give a much more satisfactory idea of the plan of treatment we would advise than in describing the treatment without reference to actual clinical cases.

CHRONIC RECURRENT APPENDICITIS.

Typical Instance.

A patient forty-four years of age, a machinist by occupation, gives the following history: Ever since he was a boy he has had occasional attacks of severe colicky pains in the abdomen. These were always accompanied by nausea, never by chills or vomiting. From the age of twenty to thirty-two he always carried some morphine pills, which he took during these attacks, which never lasted more than a few hours. At this time a diagnosis of gall stones was made. He always abstained from taking food during the attack and ate sparingly for a week or two following. At times the attacks occurred every week, then they would disappear for a month, then for six or eight months, and between the age of thirty-four and forty-two he was entirely free from actual attacks, but constantly suffered from digestive disturbances. Fifteen months ago he had a recurrence which was more severe than any he could recall. It compelled him to remain in bed for several days and left a point in the right inguinal region which was tender upon pressure. Since that time he has had eight attacks, each one a little more severe than the previous, and each sufficiently severe to prevent him from going to his work for from three to ten days. His last attack commenced ten days ago and he has been confined to bed during this time, although he has not been severely ill. During these attacks he has abstained from food for the first two to five days, and after that he would take soups and milk.

He is a slightly built man, muscular development good. Heart, lungs, liver and kidneys normal; abdomen soft. Upon inquiry he points to the right inguinal region as the seat of his trouble. Nothing abnormal can be found here except pain upon deep palpation. This also reveals an area of induration, which is, however, very small. His temperature is below 100° F., pulse 88, tongue coated.

One peculiarity to which the patient directs attention is the fact that during the early attacks the pains were spasmodic and came in waves. The patient describes them as though something were grasping a tender portion

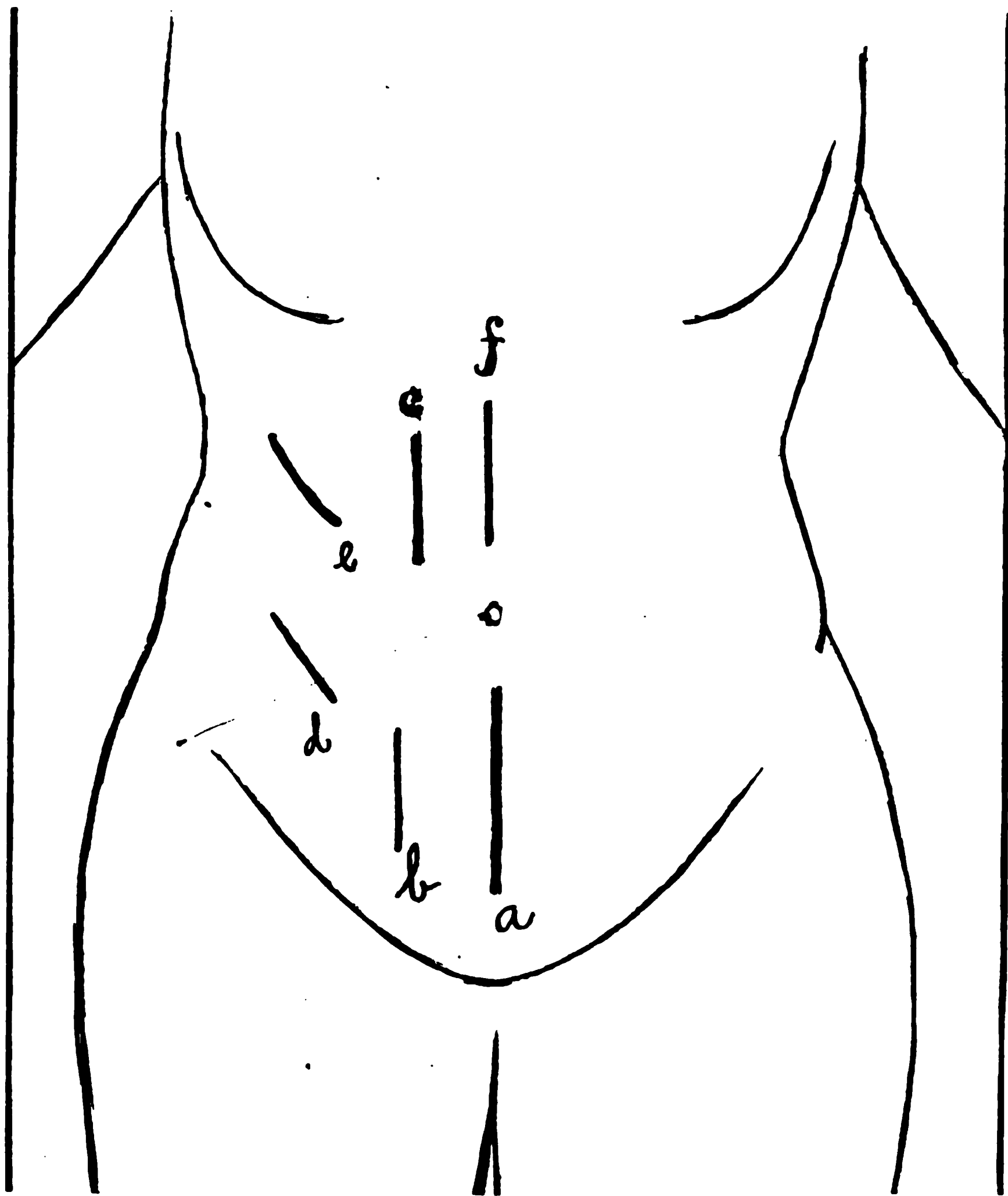


PLATE XIV.

LOCATION OF ABDOMINAL INCISIONS.

Represents the same incisions as shown in Plate XIII drawn upon the skin
The various incisions are lettered to correspond in the two plates.

of his intestine and squeezing it and then loosening the grasp, only to tighten again. During the past two years this condition has changed and now the pain is more constant and dull.

We would explain the peculiarity regarding the character of the pain by the change in the tissues of the appendix. The muscular coats have suffered severely and do not respond to irritation as they did at first, consequently the spasmodic character of the pain has disappeared.

This is not at all an uncommon history. An individual formerly in apparently perfect health and able to perform hard labor, suffers for a period from a moderate disturbance of the digestion; then there is an acute attack of appendicitis from which the patient recovers only to find the digestive disturbance exaggerated. He returns to work, but soon has a second acute attack of appendicitis, from which he again recovers, only to repeat his former experience. If he has his own business, or is engaged in the pursuit of a profession, he soon falls behind his competitors and is compelled to make great sacrifices. If he is in the service of others his employer will soon replace him by a man who can be depended upon.

Prognosis.

Many of these patients have been encountered suffering from chronic recurrent appendicitis whose prospects in life have been ruined on account of their disease. This, in itself, is an ample indication for radical treatment, provided that it will not result in complications and is not connected with much danger, but is likely to result in a permanent cure.

There are yet other valid reasons why an attempt should be made to relieve the patient permanently. *With each successive acute attack he is exposed to a certain amount of danger to life.* The fact that a patient has recovered from several attacks does not indicate that he will always in the future be so fortunate. *Each attack undoubtedly exposes the patient to much more danger than would an operation for the removal of the appendix.*

Moreover, the fact that his digestion is becoming more and more impaired is certain to affect his chances for a long life. It is likely that this indigestion results in the absorption of a considerable amount of products of decomposition. In the same way, septic material is likely to be absorbed from the lumen of the obstructed appendix.

That a permanent cure is to be looked for, after the removal of the diseased appendix, we know from clinical experience. The conditions for operation are so favorable that complications or unfavorable secondary effects are not to be expected. The general condition of the patient is fair, his temperature and pulse are normal, he is not suffering from an acute infection. It has been possible to empty the intestines thoroughly before the operation, which will facilitate the operation and the recovery. It will not be necessary to cause much traumatism, and any abrasions which may occur in loosening adhesions can readily be covered with peritoneum. It will not be necessary to drain the abdominal wound or to make this especially large, hence there need be no fear of the occurrence of a ventral hernia. Consequently we can reasonably eliminate the fear of complications.

Concerning the danger of the operation we would say that in our own experience there has been a mortality in cases like the one outlined of less than one in five hundred, or one-fifth of one per cent., and such mortality rests upon accidents which might occur with the simplest operation of any kind.

For these reasons we advise the removal of the appendix in cases of which the above is a type.

Technique.

We wish to direct attention to the fact that such a patient's abdominal walls are loose and that the intestines are not at all distended with gas. This is due to the preparatory treatment consisting in the administration of two ounces of castor oil twenty-four hours before and a sterilized liquid diet for the same period.

The field of operation being prepared in the usual way is separated from the remaining portion of the surface of the body by means of sterilized towels, a sufficient amount of space being left free so that all the manipulations necessary during the operation may be carried out without disturbing the towels, for we must not carry any infectious material from the lower surface of these towels to the seat of operation.

Abdominal Wound.

The incision is made parallel with Poupart's ligament, shown in Plates XIII and XIV d, crossing a point half way between the anterior superior spine of the ilium and the umbilicus, so that one-third of the incision will be toward, and two-thirds away from, the median line of the body as regards the above point. This incision is carried down through skin, fascia, fat and the external oblique abdominal muscle and fascia, splitting the fibers of the latter in their course. The cut through the external oblique may be made an inch shorter than that in the skin and it will still furnish a sufficient amount of space. The edges are now retracted and the direction of the fibers of the internal oblique abdominal muscle may be seen at right angles to the incision. These fibers are also separated without cutting, and we expose the strong transversalis fascia, which is closely attached to the peritoneum. This is picked up between two pairs of dissecting forceps, one in the surgeon's hand and one in the hand of an assistant. It requires a little care to avoid picking up omentum or intestines at the same time, but by lifting the transversalis fascia with one pair of forceps, then picking it up with the other, then changing the position of the first pair slightly, any intestine or omentum which may have been included at first is likely to be dropped. The transversalis fascia and the peritoneum are incised carefully, then a pair of small hemostatic forceps is applied to the edge of this wound or it is trans-fixed with needle and silk to facilitate its manipulation when the wound is to be closed.

Guides to the Appendix.

The omentum immediately comes into view crowding itself into the opening to protect the underlying intestines. When this is pushed to one side the cecum is exposed. This can be recognized by the band of longitudinal muscles extending along the anterior surface of this portion of the intestine. Following this band downwards invariably leads to the appendix. By bearing this fact in mind it is possible to find the appendix with the slightest amount of disturbance of the abdominal organs; the manipulations being confined to a very small area. Where repeated recurrences, with their acute inflammatory disturbances, have resulted in extensive adhesions, the appendix may be club-shaped at the end and somewhat bent upon itself. Its proximal third may be loosely adherent to the lower end of the cecum, while the remaining portion is strongly adherent to the anterior surface of the iliacus muscle.



PLATE XV

EXCISION OF APPENDIX

Represents the excision of the vermiform appendix, a clamp being placed at the base of the appendix, a second one upon the mesentericolum, a ligature is in position to tie the mesentericolum, the scissors are in position to cut the mesentery between the appendix and the clamp upon the former, a purse string suture has been placed about the base of the appendix upon the end of the cæcum.

Adhesions.

In separating adhesions it is always necessary to exercise the greatest care, because occasionally a small abscess may remain for a considerable period of time after an acute attack of appendicitis, and if the appendix is peeled out carelessly it is very possible for the pus to come in contact with other parts of the peritoneal cavity and a peritonitis may then occur. Again, a perforation into the cecum, or the ileum, may have occurred during the acute attack and the communication between the lumen of the appendix and the intestine may not have healed entirely, and upon removing the appendix a small intestinal fistula may be left, which again may become the cause of a peritonitis. In case there is an attachment to the cecum or ileum the surface from which the appendix has been removed should be covered at once by means of a few Lembert sutures.

Again it may happen that the lumen of the appendix at its cecal end is occluded and that the sac which is thus formed is filled with pus. Unless great care is exercised in dissecting the appendix out of its adhesions it is liable to perforate during the operation and cause an infection.

Removing the Appendix.

The removal of the appendix may now be accomplished as illustrated in Plate XV. First a pair of forceps is applied to the mesentery of the appendix. (2) The mesentery is severed between the appendix and the forceps. (3) A second pair of forceps is applied to the appendix at the point of its origin from the cecum. (4) The mesentery of the appendix is ligated and the forceps holding this structure is removed. (5) A purse-string stitch is applied from one-eighth to one-fourth of an inch from the base of the appendix. These steps are shown in Plate XV, although in practice the forceps on the mesentery is removed before the purse-string suture is applied. The presence of the forceps on the appendix facilitates the application of the purse-string suture and at the same time acts after the fashion of an angiotribe crushing the tissues of the appendix into a thin layer, as shown in Plate XVI.

The appendix is now cut away even with the forceps, care being taken to prevent leakage by applying another pair of forceps half an inch nearer the distal end of the appendix before cutting it away. The crushed stump of the appendix is then grasped by a pair of smooth dissecting forceps, as in Plate XVI or with a probe containing a fine short needle at its end, and inverted into the cecum while an assistant draws the circular stitch tightly, thus closing the defect, as in Plate XVII. The defects caused by the removal of the appendix are then covered with peritoneum by means of a few sutures and then a few more sutures are applied to cover the space occupied by the purse-string suture, as in Plate XVIII. It is not always that these last stitches are essential, but a little too much care is excusable, so long as it is harmless.

Ligatures.

In some cases the stump is very vascular, which may make it desirable to apply a fine catgut ligature to its crushed end, but this is not usually necessary. In applying the purse-string suture the needle should take a sufficiently deep bite to include all the layers down to the mucosa, the connective tissue next to the mucosa being the most important layer.

It does not matter whether fine silk or fine catgut be employed for these

sutures, but in our own practice fine silk or fine linen is used for all sutures applied to the intestinal walls. As a matter of convenience we use an ordinary straight sewing needle or a fine curved needle with the fine silk double, in order to prevent twisting and unthreading, because the sutures may be applied more rapidly in this way than by sewing with a single thread.

The entire field of operation is carefully inspected once more and if any abrasion is found this is covered with a few Lembert sutures, then the intestine is dropped into the peritoneal cavity and the abdominal wound closed in the following manner:

Closure of the Abdominal Wound

The peritoneum and transversalis fascia are first united by means of a continuous catgut suture, as in Plate XIX. In this part of the abdominal wall the transversalis fascia is strong and is sometimes likely to retract so that it is quite liable to be overlooked. As this error would weaken the abdominal wall quite a little at this point, it is well to bring both the peritoneum and the transversalis fascia together carefully with this suture.

The edges of the internal oblique muscle fall in apposition spontaneously as soon as the peritoneum and transversalis fascia have been sutured, and without any further interference there would probably be a perfect union in the layer. To insure this still more fully, however, we apply one or two, or even three, interrupted catgut sutures through this muscle, as in Plate XX. It is important to tie these sutures very *loosely*, as pressure necrosis in this position would result in retraction of the muscle and this would of course, produce a marked weakening of the abdominal wall at this point.

The edges of the wound in the external oblique muscle and fascia have been held apart by means of retractors, in order to expose the internal oblique thoroughly. These retractors are now removed and immediately the edges of the muscle and fascia approach each other. With this natural tendency of the edges in wounds of these two muscles to approximate themselves without the use of sutures, there need be no fear of the formation of a post-operative hernia, because these two strong layers extend at right angles to each other.

The edges of the wound in the external oblique muscle are now united, as illustrated in Plate XXI, care being again used not to draw the stitches too tightly for the reason given above.

In the three plates just referred to deep silkworm gut sutures are figured as placed in position, but not tied. These may be used if desired and tied after the buried sutures have been applied, but they are not necessary to secure a perfect union (and unless there is an unusual amount of tension in any case we do not use them, depending entirely upon the catgut sutures). In Plate XXII these stitches are figured as having been tied and the skin is being united by means of a continuous, buttonhole stitch of horsehair. The latter is again used double, in order to prevent unthreading of the needle. It does not matter what form of stitch, or what material is used, for the coaptation of the skin so long as the material is aseptic. A dressing of aseptic gauze is applied to the surface and held in place with broad rubber adhesive plaster strips, in order to support the abdominal wall. This is covered with a sheet of sterile absorbent cotton which is held in place with an abdominal binder.

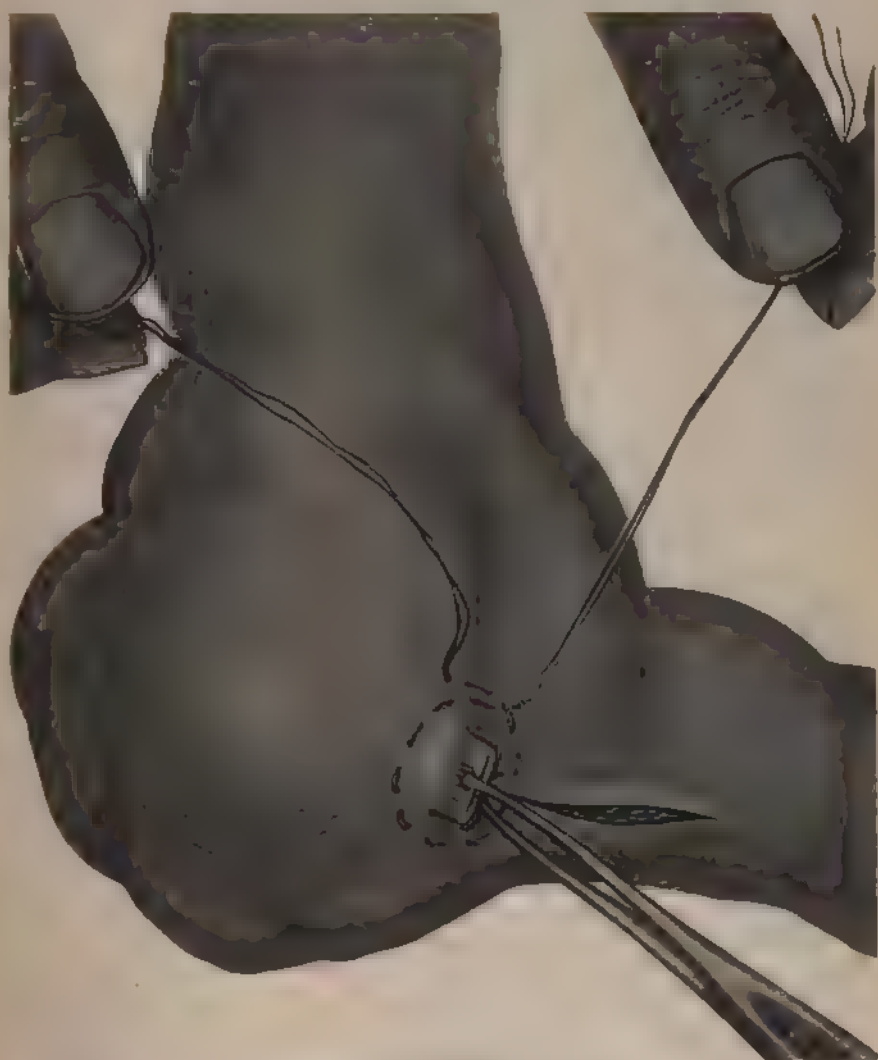


PLATE XVI

CAECUM WITH APPENDIX REMOVED

Represents the end of the caecum after the appendix has been cut away, the remaining portion showing the effects of the pressure from the clamp. The figure should show the mesenteric pedicle ligated and cut, instead of showing a slit in the peritoneum, covering the caecal end of the stump.



PLATE XVII.

EXCISION OF APPENDIX

Represents the stump of the appendix inverted into the cæcum and the peritoneum closed with sutures, the purse string suture is about to be drawn together and tied to bury the stump of the appendix



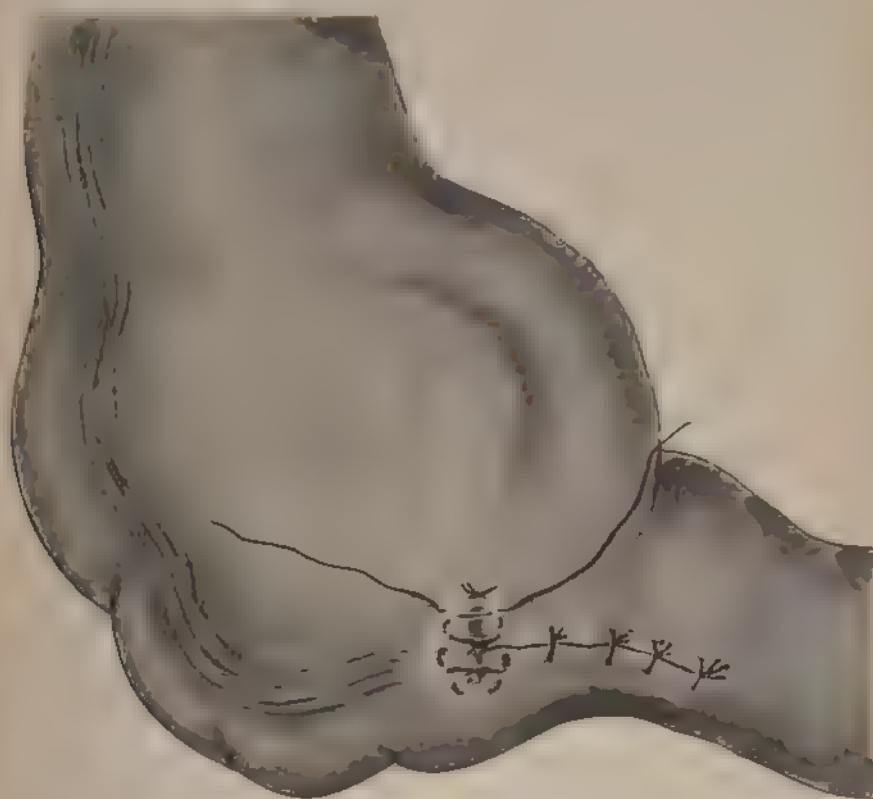


PLATE XVIII

EXCISION OF APPENDIX.

Represents the appendix butted by a second row of sutures. The longitudinal muscular band is shown to extend down to the origin of the appendix in each of these drawings of the caecum.

Pathological Appearances of Appendix.

The specimen is a little over four inches in length, which is considerably less than it was before its removal, because the longitudinal muscle fibers have been contracted, and this has resulted in a marked shortening of the organ. Its mesentery is quite thick and extends a little beyond the end of the appendix. This condition has probably served to protect the organ against more extensive destruction, because in this way a fair blood supply has been insured to the entire organ, although locally it may have suffered severely. About one-half inch from its cecal end there is quite a marked narrowing in its lumen, and by inspection and palpation one may determine the presence of a considerable amount of cicatricial tissue at this point. The narrowing is shown in Plate XXIII. Beyond this constriction we feel several hard masses in the lumen of the appendix which are undoubtedly due to fecal concretions. Upon laying open the part, these concretions show, by the irregularities forms into which they have been molded by the irregularities in the lumen of the appendix, that they must have been in this position for a considerable period of time. (Plate XXIII.) The mucous lining of the appendix shows a number of cicatrices resulting from ulcers which have healed, and at the narrowest point, near the cecum, the entire wall seems to be composed of cicatricial tissue, showing that there must have been at some time a complete destruction of a portion of the wall of the appendix. The lumen at this point is so small that a slight edema would suffice to close it entirely, and with this closure would disappear the drainage of the cavity of the appendix. The septic material present in this lumen would, of course, increase very rapidly so soon as drainage had completely disappeared, and this would result in a recurrent attack.

The digestive disturbances with which such a patient is afflicted can be explained, first, from the interference with the fecal circulation because of the extensive adhesions drawing the intestines out of place; second, from the fact that the ileo-cecal valve prevents the passage of gas and feces when there is an irritation or inflammation in the appendix, and consequently the constant inflammation in this organ for perhaps a number of years results in an almost constant obstruction to the passage of gas and feces from the ileum into the cecum, and this, of course, causes digestive disturbances.

Atypical Conditions.

In many of these instances of chronic recurrent appendicitis it is much more difficult to remove the appendix than has just been stated, because it may be located in some position from which it can be dissected only with great difficulty. A not uncommon location is on the posterior surface of the cecum. Here it is frequently completely covered with adhesions, as shown in Plate XXIV.

In these cases the end is universally club-shaped and filled with fecal material, pus or mucus. Frequently there has been a perforation between the appendix and the cecum, and occasionally there is a fistula which has persisted for a long time. The cecum, together with the appendix, may be united by adhesions to the anterior surface of the iliacus muscle or to the omentum, or to both. The appendix may also be displaced very greatly. It has been found attached to the left of the median line, even to the border of the spleen. We have found it attached to each of the pelvic organs, uterus, bladder, ovaries, tubes, sigmoid flexure and rectum; also to the small intestines, to the anterior abdominal wall and to the gall bladder.

Indeed, with a long, free cecum there is no reason why the appendix should not be found attached to any point within the abdominal cavity.

Many times we have seen the appendix twisted upon itself like a snail and held in this position by adhesions, making the evacuation of its cavity practically impossible. In many cases there are several strong adhesions at various points in the course of the appendix, making short bends, which have a tendency to obstruct its lumen. The distal end of the appendix may project beyond the last one of these adhesions and form a free, sac-like projection.

It frequently happens that the strong adhesions are located opposite a point at which there was a perforation in the appendix during an acute attack. This will, of course, still further obstruct the lumen of the appendix at this point.

Plate XXVI represents an appendix which is fairly normal both at its cecal and its distal end, but severely obstructed at three intervening points on account of short bends due to strong adhesions.

Occasionally an appendix is found in which the greater portion of the structure has been destroyed by gangrene and has been absorbed, leaving only a small, string-like structure along the edge of the mesentery of the appendix. Again, the cecal end may have been destroyed in the same way, leaving the distal end without communication with the cecum. This condition is likely to be troublesome because it leaves a sac lined with mucous membrane containing septic material without drainage into the cecum.

In still other cases the appendix has become so intimately united with the posterior surface of the cecum that it can be discovered only after the most careful search has been made, because both the appendix and the underlying cecum are covered with a broad sheet of connective tissue which has almost perfectly the appearance of peritoneum. In these instances it frequently happens that the proximal end of the appendix is entirely occluded and that the distal end contains septic material which gives rise to the recurrent attacks of appendicitis, which subside only when the abscess formed has perforated into the cecum.

The longitudinal band of muscle fibres serves better than any other guide to the discovery of the location of the appendix in these examples.

The operator may easily be deceived in searching for the appendix, in the interval in recurrent appendicitis, by the presence of a small mass of fat at the lower end of the cecum. This may lead him to suppose that the appendix has been entirely destroyed on account of gangrene and that all that is left is simply the fat mesentery of the appendix. Careful inspection will usually show that this mass of fat consists of a small portion of omentum which has surrounded the appendix and has become thoroughly adherent to the latter or to its remnant after the portion destroyed by the disease has been absorbed. So long as the operator follows the longitudinal muscle band upon the anterior surface of the cecum, and at the same time is as careful as possible not to injure the walls of the loops of intestine which may be adherent, his search for the appendix may be conducted with relative safety.

Important Conclusions.

The important points to be borne in mind in connection with recurrent appendicitis are: 1. The patient's opportunities for professional or business prosperity are greatly limited by the frequent interruptions due to the

disease. 2, He is deprived of many of the ordinary pleasures of life. 3, He is constantly in danger of suffering from a serious attack. 4, His digestion is impaired and his nutrition is correspondingly reduced. 5, He is forced to absorb septic material during a considerable portion of the time. 6, During any attack any of the various complications resulting from acute appendicitis may occur. 7, So large a proportion of these cases suffer from gall stones that this condition may be reasonably looked upon as being secondary to the appendicitis.

All of these conditions can be eliminated by an operation which in itself is not accompanied with as much danger as there is in any one attack of recurrent appendicitis, and which will confine the patient for a very short time, provided, always, that the operation is performed by a safe surgeon and *after the acute attack has subsided completely.*

ACUTE PERFORATIVE APPENDICITIS.

Typical History.

The patient is fourteen years of age, a school girl, slightly built, and not well developed for her age. She has never been strong since infancy, which she attributes to the fact that she suffered from measles and scarlet fever while very young. Her nutrition has always been imperfect and her appetite unnatural, being either ravenous or entirely absent. Her bowels have been constipated and abdomen bloated. She has menstruated since one year ago at irregular times and has suffered severely from pain in the region of the right ovary during each period. The pain has been spasmodic and so severe that the use of anodynes seemed necessary for her relief. She never suffered from severe pain at any other time, although she occasionally had slight attacks of colic in the epigastric region whenever she was especially careless about eating. Three days ago, immediately after an unusually large dinner the patient suddenly experienced severe pain over the entire abdomen, but which was more intense in the vicinity of the umbilicus.

The patient was put to bed and hot cloths were applied to the abdomen, affording only very slight relief; she was then given a large dose of salts, followed by a cup of hot water. Being slightly nauseated before, this condition increased very rapidly, resulting in severe vomiting, which has persisted at intervals ever since. Two days ago she received several enemata, one of which was followed by the expulsion of gas and some feces. The patient received soups and milk by mouth, but could not retain the nourishment more than a few hours at a time, when she would vomit whatever had been taken. All remedies administered to relieve the nausea and vomiting were of no avail. Several further enemata were given without effecting the expulsion of gas or feces. The abdomen became more and more tympanitic and the pain became so severe that morphia had to be used hypodermically. The pulse increased to 130 beats per minute and the temperature to 102.5°. The pain has become localized in the right inguinal region.

The general appearance of the patient is extremely unsatisfactory. She gives the impression of one who is almost hopelessly ill. She has an anxious, restless expression. Her breathing is entirely costal, rapid and short. Her abdomen is severely distended and more prominent in the right inguinal region than in the left. The abdominal muscles are exceedingly tense, especially on the right side. The patient shrinks if she notices any one ap-

proaching the bed, although she seems too ill to show interest in anything else.

Upon percussion we find a little difference in resonance in the two inguinal regions, but neither side gives a dull or a flat sound. The patient complains of pain from percussion on the right side.

Upon examination through the rectum we find this organ distended with gas above the internal sphincter, which is supposed to indicate the presence of diffuse peritonitis. On the right side the finger perceives a fullness, but no fluctuation. Her thighs are drawn up to relieve the tension of the abdominal muscles. The nurse has placed a pillow under her knees to make this position more comfortable. The patient's temperature is nearly 103° F. and the pulse 130 beats per minute and very feeble. Her tongue is thickly coated and the edges are red in small spots. She is intensely thirsty, but does not retain the liquid given to her.

The patient is evidently suffering from acute perforative appendicitis with beginning diffuse peritonitis. This may be due to the perforation of an ulcer which has existed for a considerable period of time, or to gangrene of the appendix, from thrombosis of some of its vessels or to the perforation of an appendix distended with pus with its cecal end occluded by cicatricial tissue. The patient is extremely ill, and it is plain that unless the method of treatment employed during the past three days is radically changed she cannot survive long.

Considerations of Treatment.

So far the patient has received the treatment prescribed by many of the leading text-books on internal medicine. She has been limited to liquid diet, has received saline cathartics and enemata, has had hot applications to the abdomen, and when the pain has been unbearable opium was employed only in sufficient doses to overcome the severe distress.

There can be no doubt from the progress of the disease that such treatment was extremely unfortunate in this case. We believe that this form of treatment should be condemned in every case of acute appendicitis, because it contains nothing which can be useful for the relief of the pathological conditions present, while it includes many features which are extremely harmful, as we shall see presently.

The giving of cathartics of any kind during acute gangrenous or perforative appendicitis at any time during the attack has undoubtedly destroyed more lives than surgery has saved in this disease.

The question arises, What can we do for this patient that will be of greatest benefit to her and may possibly rescue her from the present apparently hopeless condition?

Many authors advise an immediate operation in all cases of acute appendicitis without regard to the condition of the patient or the stage of the attack, unless the patient is moribund on the one hand or improving rapidly under the treatment which is being employed at the time the surgeon is called.

Although this example patient is very ill, she is not moribund, consequently this case would come under the class in which an immediate operation is advised by these authorities. In our experience, and in that of all surgeons whose work we have had an opportunity to observe, patients with the conditions of the case described have almost invariably died within twenty-four or forty-eight hours after the operation. They therefore belong



PLATE XIX

McBURNIE'S INCISION.

Represents McBurnie's incision for the removal of the vermiform appendix, the deep silk worm gut sutures are in place, but not tied, the peritoneum and transversalis fascia being united with a separate row of continuous cat-gut sutures, the internal oblique abdominal muscle being split with the edges still separated. The edges of the external oblique abdominal muscle are held apart with retractors.

It is not necessary to insert the deep silk worm gut sutures, the catgut sutures uniting the various layers being quite sufficient to secure perfect and permanent union.

to a class in which operative treatment has an especially high mortality. In fact, by far the greater portion of all fatal cases following appendicitis operations belong to this class. These cases have been said to be too late for an early, and too early for a late operation.

Our experience has been quite different with a form of treatment which we will proceed to set forth. Of course, no form of treatment can save every case of perforative appendicitis, especially if the patient has received cathartics and food by mouth before he comes under care, but in cases like the one depicted we would estimate the proportion of recoveries at about ninety per cent. if the method which we recommend be employed.

Taking all cases of gangrenous and perforative appendicitis together, as a class, as they come under our care at the hospital those that are like the case named and those that are not so severe but still having gangrene or perforation present, and those that are still worse, our mortality is now a little less than two per cent.

Had it been possible from the beginning to confine the septic material to the vicinity of the appendix, the patient's condition would never have become as serious as at the present time, because her serious condition is undoubtedly due to the fact that the septic material has been distributed over a considerable portion of the peritoneum.

Anatomical Surroundings of the Appendix.

In order to comprehend fully the treatment we advise in this class of cases, it will be necessary to direct attention to the anatomical location of the appendix.

The appendix is virtually surrounded on all sides, excepting in the direction of the median line, by relatively fixed tissues. Above we find the lower end of the cecum and the cecal end of the ileum; to the right and in front is the parietal peritoneum; behind the peritoneum covering the iliacus muscle; and toward the median line it is surrounded by loops of small intestines. Moreover, the omentum extends far beyond its lower end. (In small children the omentum is so slight in many cases that it cannot be considered of great value in protecting a gangrenous appendix.)

It is true that the appendix may be displaced downward, but in this event it will again be surrounded by fixed tissues which seem especially adapted to dispose of septic material. Again, there may be an enteroptosis affecting the cecum, and always with this a marked lowering of the transverse colon and stomach, and with these, the omentum.

It may also be displaced upwards and backwards in which instance the cecum is in a position to furnish perfect protection; or upwards and forward when the omentum will be able to surround it on all sides.

Thus we see that the natural anatomical arrangement for the protection of the general peritoneal cavity is extremely efficient. There is but one weak point in the anatomical provision for this protection, namely, in the direction of the median line, because the great mobility of the small intestines naturally favors the distribution of septic material to all parts of the peritoneal cavity. If we can prevent the small intestines from doing harm in this direction, we will have accomplished our end, theoretically at least.

At this juncture let us direct attention to another important anatomical condition. The blood supply of the omentum is so enormous that it will readily dispose of a very severe infection by walling off the surrounding structures if it is permitted to give its physiological attention to a single area.

It is a well-known fact, which every one who frequently operates during the acute attack of appendicitis has had many opportunities to observe, that the omentum crowds itself about any inflammatory or traumatic lesion within the peritoneal cavity the moment such lesion occurs, and if left undisturbed a few hours will suffice to cause efficient protective adhesions. *These adhesions become stronger every hour and the blood supply in the omentum becomes greater, so that if no disturbance arises one can reasonably expect efficient protection to the general peritoneal cavity from the omentum.*

Another important fact must not be lost sight of in this connection, viz.: that the surrounding structures being relatively fixed in position favor the condition of rest of the inflamed part and permit the omentum to act after the manner of a splint applied to an inflamed joint. The value of rest as a preventative to the extension of an infection in any part of the body cannot be overestimated. Consequently, if it is possible for us to secure this condition of rest we have gained another important point in the right direction.

Should the appendix be displaced upwards its position is even more favorable, because the available amount of omentum is thus increased. Again, if the appendix is retro-cecal in its position, which is very frequently the case, the infection of the general peritoneal cavity is more easily prevented than when in its normal location. If anteriorly misplaced it is likely to be fastened to the anterior abdominal wall by the adherent omentum.

Peristaltic Motion of the Small Intestines.

It is plain, then, that the infection of the general peritoneal cavity must occur from a disturbance on the part of the small intestines and must be due to their peristaltic motion.

It is significant that in almost all cases of severe, acute appendicitis the obstruction to the passage of gas and intestinal contents through the ileo-cecal valve is one of the early symptoms, a condition which was present throughout the attack in the case typified. Nature is trying to prevent this very dangerous disturbance by closure of the ileo-cecal valve. We have a condition corresponding to the contraction of the muscles surrounding an inflamed joint; to the closure of the eye-lids in conjunctivitis, etc. Moreover, the muscles overlying the appendix become tense. Everything tends toward the establishment of conditions of *rest* in the vicinity of the inflamed organ.

The Effect of the Introduction of any Kind of Food or Cathartic into the Stomach.

It is a fact which has been demonstrated a great number of times that peristalsis does not occur unless food or cathartics are introduced into the stomach. If the attack occurs shortly after a meal and before all of the food has passed through the ileo-cecal valve, its presence may cause peristaltic motion in the small intestines. Upon reaching the ileo-cecal valve the latter may prevent its passage into the cecum, causing return peristalsis, and the intestinal contents are forced back into the stomach, from which cavity again to be expelled by vomiting, or again forced into the small intestines, giving rise to further peristaltic motion. Moreover, it will give rise to the formation of gas, which must cause disturbance and pain in its attempt to pass the ileo-cecal valve.

This motion, it is plain, will be harmful primarily from the fact that it gives rise to pain by disturbing the sensitive, inflamed tissues; and, second-

arily, from its likelihood of carrying infectious material, with which the intestines or the omentum have come in contact in the vicinity of the inflamed appendix, to other parts of the peritoneal cavity.

Besides this the physiological attention of the omentum cannot be directed to the single area of infection, because other parts of the peritoneal cavity require its protection, and such portions of the omentum as are not yet thoroughly adherent about the inflamed appendix are inclined to be diverted from this point.

Theoretically, then, the disturbance which is to be feared to so great an extent is caused by the presence of food or cathartics in the stomach and intestines, and its logical remedy would be to absolutely prevent the introduction of any form of food or cathartics into the stomach and the removal by gastric lavage of any portion of food that may be retained in the stomach at the beginning of the attack. It may be necessary to perform gastric lavage twice, or at most three times, in order to entirely remove remnants of food which may have regurgitated into the stomach from the small intestines by reason of return peristalsis. That this is not only true theoretically, but also in practice, we have demonstrated in a large number of cases; and many other surgeons who have followed the same plan of treatment have informed us of the fact that their experience has agreed with ours.

It is true that a few surgeons have reported failures with this method, but an investigation of their treatment in each instance has shown that they disregarded one of the three cardinal points in the treatment. They either gave just a little liquid food by mouth, or they gave some form of cathartic, or disturbed the rest of the intestines by giving large enemata, or they neglected removing the stomach contents by gastric lavage.

Of course, the slightest amount of food is sufficient to start peristaltic motion of the small intestines, and the same is true of cathartics, and consequently if either of these features in the treatment be omitted one cannot hope for the same results. Even water given by mouth will frequently start peristalsis, and when given rapidly by rectum in the form of enemata the same harmful effect is often experienced, while this is not the case if normal salt solution be given by rectum continuously by the drop method introduced by Murphy.

Starvation Plan of Great Value Unqualifiedly.

It seems clear that this plan of treatment must be useful, in any given case, no matter what form of appendicitis may be present, because in the milder cases it will result in rest of the affected part, and consequently rapid resolution; in the severe cases it will guard against mechanical distribution of infectious material; and in all cases it reduces the tendency to meteorism and stops the pain.

We wish, therefore, once more to impress every one who reads this with the important fact that no matter what form of treatment he may have decided to carry out in any given case of acute appendicitis his patient will be safer and more comfortable, and will make a more rapid recovery with fewer complications, if he makes use, in addition to the treatment contemplated, of the plan just described.

A Great Change in Mortality.

There is, particularly, one class of patients in which we have found this treatment of the greatest value. We refer to the class in which the

appendix is gangrenous or perforated and in which there is already a beginning of general peritonitis. These patients give the impression of being profoundly ill. There is complete obstruction to the passage of gas and feces. There is nausea or vomiting and marked meteorism; the pulse is small and quick; usually there is high fever, but the temperature may be subnormal; respiration is rapid, superficial and costal, and the abdominal muscles overlying the appendix are tense—conditions corresponding to those we have just clinically outlined. The patient is in a state in which we formerly operated at once, day or night, as a last resort, only to find that it was too late in more than one-third of the number of cases, the mortality increasing with the time that had elapsed since the beginning of the attack.

In this class of cases there is now a recovery of over ninety per cent., and if all cases of acute gangrenous and perforative appendicitis are counted, of over ninety-eight per cent., if the principles laid down above be thoroughly applied.

If peristalsis is inhibited, as it can usually be, the infection will become circumscribed and the pus can be evacuated with safety. Moreover, the condition we have just described is in itself the result of the administration of food and cathartics. Had these patients received neither food nor cathartics from the beginning of their attack, the affair would never have advanced to this dangerous point. This refers particularly to a class of cases which Richardson has so well described as being "too late for an early, and too early for a late, operation."

If the plan we have outlined above is carried out the following changes are quite certain to occur: The nausea and vomiting will cease after one or two, or at most three, gastric irrigations. The meteorism and the pain will decrease greatly during the first twelve hours and will almost completely disappear in twenty-four hours. The pulse will become slower and firmer and more regular; the breathing deeper and the patient's general appearance will improve to an astonishing extent. The temperature will go below 100° F. the first twenty-four hours, and in three days it will be practically normal. The abdominal muscles will become soft as soon as the stomach contents have been removed by gastric lavage.

Usually the improvement is so rapid that one is tempted to spoil everything by giving nourishment by mouth, because the patient's condition does not seem serious enough to warrant such severe deprivation measures.

That this form of treatment—which we have employed since 1892, at first only in selected cases and later more and more generally—is really of great value is shown by clinical results. Our mortality in cases of perforative or gangrenous appendicitis with beginning diffuse peritonitis is less than one-fourth as high as it was in the cases operated at once upon making the diagnosis, and even in advanced cases of diffuse peritonitis there has been a marked decrease in the mortality in our experience.

It might be said that these cases were not due to perforative or gangrenous appendicitis, but that they were simply severe catarrhal cases, which are known to result favorably under any form of treatment. To this we would respond that we have later removed the appendix in many of these cases and have almost invariably demonstrated the correctness of the diagnosis.

Gastric Lavage Imperative.

It might seem impossible, returning to our clinical case, to remove more



PLATE XX.

ABDOMINAL WOUND.

Represents the next step in the closure of McBurney's incision, the internal oblique abdominal muscle having been united with interrupted cat gut sutures.

substance from the stomach after she has vomited so frequently for a period of more than two days. Frequently physicians have considered this step superfluous, because they have imagined that the stomach must surely be empty under these conditions. This is, however, a very serious error. The fact that the patient is suffering from nausea or vomiting is the strongest indication for the use of gastric lavage, because the nausea is caused by the presence of decomposing material in the stomach and its removal must result in the greatest benefit. It frequently happens that these patients lose their anxious expression and restlessness, which we have observed in this case, and that the skin becomes warm and moist and they begin to sleep directly after the gastric lavage has been practised.

Were a person in perfect health to place in his stomach the amount of decomposing food and mucus which we have just washed out of the child's stomach, he would at once become violently ill, and consequently the effect of this substance upon a patient whose strength has been exhausted by a severe acute illness must certainly be still worse. It is possible that there may be more material of the same character in the small intestines, but if so it will soon regurgitate into the stomach and make its presence known by the recurrence of nausea. Should this occur the gastric lavage should be repeated at once. If no food is given by mouth we have never been compelled to irrigate the stomach more than three times in the same patient, and usually one careful, thorough irrigation will suffice.

Technique of Lavage.

It will be wise to direct attention to the method employed in such cases. The patient is turned upon the right side in order to add the weight of the intestines to the support of any adhesions which may exist in the vicinity of the appendix. The head and shoulders are slightly elevated by means of pillows or a head-rest, or by elevating the head of the bed from thirty to fifty cm., then the pharynx is sprayed with a four per cent. solution of cocain in order to prevent gagging when the stomach tube is passed, because this might disturb the adhesions in the vicinity of the appendix. It is well to spray the pharynx repeatedly for a period of about five minutes, permitting the patient to swallow a little of the saliva mixed with cocain in order to anesthetize the esophagus to some extent at the same time. Not more than one teaspoonful of the cocain solution should be placed in the atomizer in order to avoid harm from cocain poisoning. After holding the cocain in the pharynx a minute it is expectorated with the saliva which has accumulated and a fresh spray is applied. As most of the cocain is thus thrown out there is no danger from poisoning. After about five minutes a fairly large stomach tube is inserted and the contents of the stomach siphoned out. The stomach tube should have one or two lateral openings aside from the opening at its end. These openings should be within one to two inches from the end which is inserted in the stomach. This will prevent the end of the tube from becoming closed by drawing into it a portion of the mucous lining of the stomach.

Whenever there is any interruption in the flow this may be overcome by pouring a little water into the tube and thus dislodging any substance which may have become fixed therein.

After the accumulation which is present in the stomach has been siphoned out it is well to introduce into the stomach a pint of normal salt solution at 100° F. and then siphon it out. This may be repeated until the

fluid returns clear. It is well in these cases to elevate the foot of the bed about thirty inches just before withdrawing the stomach tube, after completing gastric lavage, and then to withdraw the tube slowly. In this manner it is possible to leave the stomach completely empty.

The Fowler Position.

The patient should now be placed in bed with shoulders somewhat elevated so as to favor gravitation toward the pelvis. The position introduced by Fowler, which is accomplished by elevating the head of the bed twenty-four to thirty inches, seems to be very useful in these cases, and we have practised placing our patients in this position constantly since Fowler demonstrated its value. She should receive absolutely no food and no cathartics by mouth. Every four hours she should have an enema of an ounce of one of the concentrated predigested foods dissolved in three ounces of normal salt solution. We are confident that she will not require any anodyne, her pain will disappear spontaneously, since we have removed the cause of irritation by performing gastric lavage. It is, however, perfectly safe after performing gastric lavage to give the patient from ten to thirty drops of deodorized tincture of opium in each rectal feeding until the pain has completely subsided, should it persist after the gastric lavage has been completed. This would, of course, be extremely harmful were any food or cathartics to be given. In the meantime we will observe the patient carefully, because it is quite possible that a circumscribed abscess may develop in the right inguinal region. If this should occur we will simply drain the abscess. It is surprising to observe how much infection will be disposed of by the peritoneum and the omentum, and how extensive an infection of the peritoneum will subside completely, if one will only secure a condition of rest to the small intestines and thus prevent the further infection of the portions of peritoneum away from the point of primary infection in the vicinity of the vermiform appendix.

Exceptionally Unfavorable Classes.

There are two classes of patients in whom this form of treatment is not so satisfactory as it is in all other classes, namely, the very old and the very young. Very old patients do not bear confinement in bed well, no matter what their condition may be, and they do not prosper generally on rectal feeding. In these cases one is compelled to choose between two evils, and whichever is chosen one usually wishes it had been the other.

It should be stated here that very old patients bear confinement in bed much better when kept in the Fowler position than when kept in the horizontal position, and since the introduction of this feature we have never had a case of hypostatic pneumonia in one of these aged patients because of their confinement to bed.

In children it is difficult to perform gastric lavage, they are likely to struggle and injure themselves while this is being accomplished. The same is true of administering rectal feeding. Moreover, the omentum in small children is not sufficiently developed to act as an efficient protection. It is consequently wise in these two classes to operate whenever the patient's condition indicates that he will probably recover from the operation.

Return to Diet.

After the patient has recovered from the acute attack, which can be determined from finding the temperature and pulse normal, the diminished

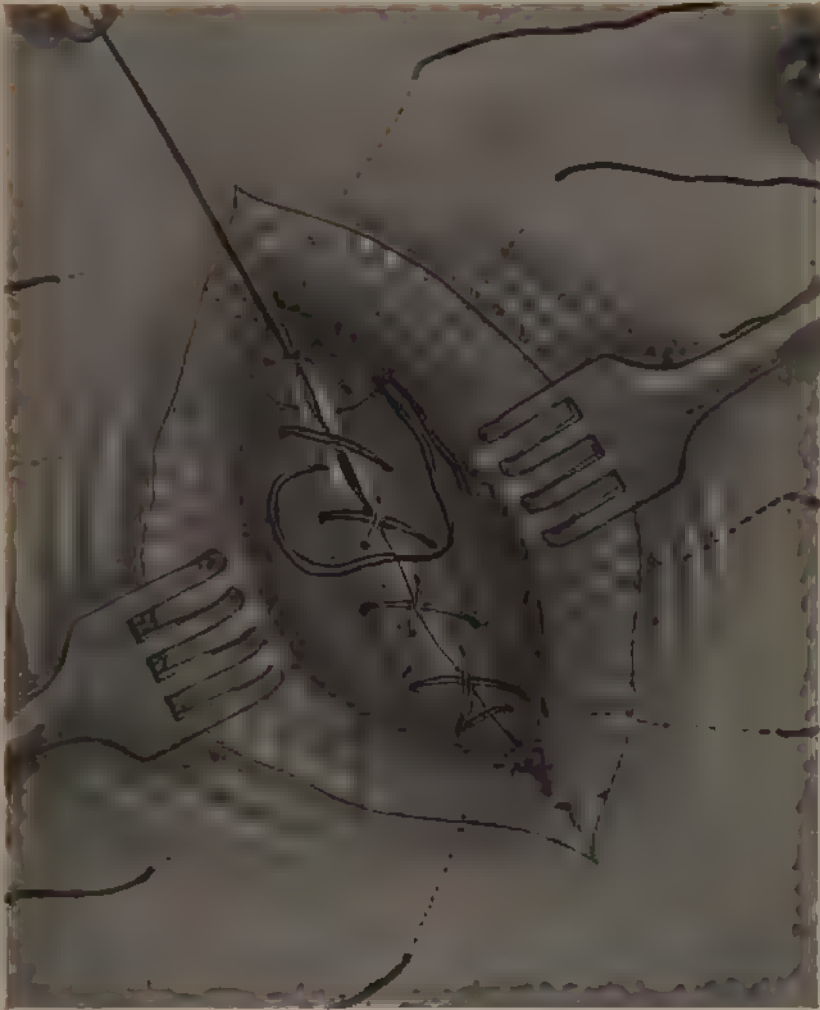


PLATE XXI.

ABDOMINAL WOUND.

Represents the next step in the closure of McBurney's incision, the fascia of the internal oblique abdominal muscle having been united with a continuous cat-gut suture.



PLATE XXII

CLOSURE OF ABDOMINAL WOUND

Represents the last step in the closure of McBurney's incision, the deep silkworm gut sutures and the coaptation sutures for the skin having been applied

rigidity of the abdominal wall, pain and tenderness upon pressure absent, the obstruction to the passage of gas and feces relieved, feeding by mouth may be commenced gradually. It is well to give a small cup of beef tea made from some of the commercial beef extracts every three hours at first, because this will serve to encourage the patient, while it will not give rise to peristaltic motion as it is absorbed from the stomach, being composed almost entirely of non-irritating soluble substances. Later milk and lime-water, soups, broths and gruels may be allowed. We believe that it is well not to operate in these cases, after they have recovered from the acute attack, until they are in a condition in which it seems perfectly safe to give the ordinary dose of castor oil which we are in the habit of administering in preparing patients for abdominal operations. Of course this should not be given so long as there is any doubt regarding the complete recovery, because if given too early it might be the cause of recurrence. If the oil causes no disturbance it is fair to suppose that the patient has fully recovered from the acute attack and is in a favorable condition for obtaining radical relief.

Many patients refuse to be operated after they have recovered from the acute attack, and until the past few years we frequently had a patient come under our care on the third to the seventh day of an attack of acute perforative or gangrenous appendicitis whom we would treat through the acute attack with the method just described, but who would refuse operation during the interval. Later a number of these patients had recurrent attacks and were treated with cathartics or were operated during the third or fourth day of a severe acute attack and thus lost their lives unnecessarily.

Later Appendectomy.

To avoid this we have followed the plan of confining these patients to liquid diet until the appendix has been removed, even if this is postponed for several months. If they change to solid food they usually experience some discomfort, and fearing another acute attack, have returned for operation and in time to have an *interval* operation.

We have many times made the error of operating too soon after an acute attack, but never has the interval been too long in cases in which the patient took nothing but liquids, together with soft boiled eggs, mush, purees, custards, boiled rice and thoroughly cooked cereals after recovering from the acute attack until the interval operation had been performed.

Confirmatory Testimony.

Since the publication of the second edition of this work, thousands of practitioners of medicine and surgery, and many distinguished surgeons who were not convinced of the correctness of our views concerning this subject at that time, have thoroughly tested the method and have either privately or publicly stated that by adding this plan to their former conception of the indications for treatment of this disease, they have succeeded in reducing their mortality to a very marked extent.

Our own experience has still further confirmed the correctness of the views expressed in the first and second editions. Circumstances have been such that we have had an opportunity to demonstrate an enormous number of these cases to many surgeons from all parts of this and other countries, so that at the present time we need but repeat the indications expressed on this subject in the first and second editions, viz:

Conclusions.

In order that our views concerning the treatment of appendicitis may

be perfectly understood, we here repeat the conclusions which were formulated some time ago and which have been followed throughout in the treatment of all of our cases.

1. The mortality in appendicitis results from the extension of infection from the appendix to the peritoneum, or from metastatic infection from the same source.

2. This extension may be prevented by removing the appendix while the infectious material is still confined to that organ.

3. The distribution or extension of the infection is accomplished by the peristaltic action of the small intestines.

4. It is also accomplished by operation after the infectious material has extended beyond the appendix and before it has become circumscribed.

5. Peristalsis of the small intestine can be inhibited by prohibiting the use of every form of nourishment and cathartic by mouth and by employing gastric lavage in order to remove any food substances or mucus from the stomach.

6. The patient can be safely nourished during the necessary period of time by means of nutrient enemata. Large enemata should never be given, for they may cause the rupture of an abscess into the peritoneal cavity.

7. In case neither food nor cathartics are given from the beginning of the attack of acute appendicitis, and gastric lavage is employed, the mortality is reduced to an extremely low percentage.

8. In cases which have received some form of food and cathartics during the early portion of the attack, and are consequently suffering from a beginning diffuse peritonitis when they come under treatment, the mortality will still be less than four per cent. if peristalsis is inhibited by gastric lavage and the absolute prohibition of all forms of nourishment and cathartics by mouth.

9. In this manner very dangerous cases of acute appendicitis may be changed into relatively harmless ones of chronic appendicitis.

10. In our personal experience no case of acute appendicitis has died in which absolutely no food of any kind and no cathartics were given by mouth from the beginning of the attack.

11. The mortality following operations for chronic appendicitis is exceedingly low.

12. Were peristalsis inhibited in every case of acute appendicitis by the methods described above, absolute prohibition of food and cathartics by mouth and the use of gastric lavage, appendectomy during any period of the attack could be accomplished with much greater ease to the operator and correspondingly greater safety to the patient.

To Reduce the Mortality from Appendicitis.

The following suggestions for the treatment of appendicitis are made with a view of reducing the mortality:

1. Patients suffering from chronic recurrent appendicitis should be operated on during the interval.

2. Patients suffering from acute appendicitis should be operated on as soon as the diagnosis is made, provided they come under treatment while the infectious material is still confined to the appendix, and if a competent surgeon is available.

3. Aside from insuring a low mortality this will prevent all serious complications.

4. In all cases of acute appendicitis, and in all cases of peritonitis, without regard to the treatment contemplated, the administration of food and cathartics by mouth should be absolutely prohibited and large enemata should never be given.

5. In case of nausea or vomiting, or gaseous distention of the abdomen, gastric lavage should be employed.

6. In cases coming under treatment after the infection has extended beyond the tissues of the appendix, especially in the presence of beginning diffuse peritonitis, conclusions four (4) and five (5) should always be employed until the patient's condition makes operative interference safe.

7. In case no operation is performed neither nourishment nor cathartics should be given by mouth until the patient has been free from pain and otherwise normal for at least four days.

8. During the beginning of this treatment not even water should be given by mouth, the thirst being quenched by rinsing the mouth with cold water and by the use of small enemata. Later small sips of very hot water frequently repeated may be allowed, and still later small sips of cold water. There is danger in giving water too freely, and there is great danger in the use of large enemata.

9. All of these cases are greatly benefited by the use of continuous normal salt solution by rectum, given according to Murphy's directions.

10. All practitioners of medicine and surgery, as well as the general public, should be impressed with the importance of prohibiting the use of cathartics and food by mouth, as well as the use of large enemata, in cases suffering from acute appendicitis or peritonitis.

11. It should be constantly borne in mind that even the slightest amount of liquid food of any kind by mouth may give rise to dangerous peristalsis and may change a harmless, circumscribed into a dangerous, diffuse peritonitis.

12. The most convenient form of rectal feeding consists in the use of one ounce of any of the various concentrated liquid predigested foods in the market, dissolved in three ounces of warm normal salt solution, introduced slowly through a soft catheter, inserted into the rectum a distance of two to three inches.

13. This form of treatment cannot supplant the operative treatment of acute appendicitis, but it can and should be used to reduce the mortality by changing the class of cases in which the mortality is greatest into another class in which the mortality is very small after operation.

14. It is important to bear in mind the fact that this treatment is always indicated without regard to whether an immediate operation is or is not contemplated.

15. It is further important not to be deceived by the very rapid improvement of what appear to be serious cases into the belief that the case is not a gangrenous or perforative appendicitis, because such patients may easily be killed by giving food too early.

Diagnosis.

In order to treat patients suffering from appendicitis with the greatest degree of success, it is important to make a careful, early diagnosis. This will depend upon two conditions:

A Careful Physical Examination.

This should be made in every case in which there is any symptom of

intra-abdominal disturbance. It has been our experience to find that a mistaken diagnosis at the beginning of an attack of appendicitis has usually resulted from the fact that the family physician, when first called, was willing to make a diagnosis of gastritis, or enteritis, or catarrhal disturbance of the alimentary canal, from the symptoms given by the patient or his friends, without himself making a physical examination in order to ascertain the actual state of affairs. This is true even more commonly in children than in adults. Until very recently more than ninety per cent. of all cases of appendicitis in children came into our hospital service with a diagnosis of gastritis, and more than fifty per cent. had not been subjected to a physical examination.

Only a few years ago more than fifty per cent. of all women entering the hospital suffering from appendicitis came with a diagnosis of tubal infection. This error was so common at that time that many of the best authors upon this subject of appendicitis stated that the disease occurred much more frequently in men than in women. (Deaver, Fowler, Mynter, etc.)

A careful physical examination will, of course, usually eliminate these errors, and will enable the physician to prevent the patient from doing things which must certainly increase the gravity of the disease, and which undoubtedly are frequently responsible for the fact that the correct diagnosis is not made until the patient is almost or quite in a hopeless condition. We would consequently insist upon making a careful physical examination in every patient the first and most important step toward securing proper treatment in cases of appendicitis.

Clinical Experience.

Nothing serves so well to aid a physician in comprehending proper treatment of these cases as the observation of some of the various forms of appendicitis throughout their course, and especially through the necessary operation. This is true particularly of physicians practising internal medicine. One can really not have a clear idea of the behavior of a diseased appendix unless he has observed it in all stages of disease in the living human body. It is such a natural matter to imagine, when the acute condition subsides, that the amount of disturbance must have been slight, that unless one has an opportunity later to demonstrate the actual condition by removing the appendix he is not likely to appreciate the gravity of the disease in ordinary acute cases.

On the other hand, unless one has observed the intra-abdominal condition during the acute attack in some of the most desperate cases of acute perforative or gangrenous appendicitis, in which the removal of the organ seemed impossible even in the hands of the most skillful surgeon, and a year or more subsequently at a second operation the almost normal condition of everything within the abdominal cavity, with the exception of the appendix itself and possibly a few unimportant adhesions, he is hardly competent to appreciate what Nature can accomplish within the peritoneal cavity.

In order to become familiar with these pathological conditions we believe the student of medicine and the practitioner doing post-graduate work should observe these cases before, during and after operation in the great hospitals where such examples are numerous, and they should study the pathological condition in the living patient. In the study of these processes in the living patient one is impressed with certain facts which it is believed have a very important bearing upon the treatment of appendicitis.

Drainage of the Appendix.

So long as the appendix is in a condition in which its lumen is thoroughly drained the organ will not cause any serious trouble, and just in the proportion in which this drainage is interfered with will the danger to the patient increase.

Primarily, the obstruction is always due to an inflammation, either directly because of the accompanying congestion or edema, which in itself may suffice to obstruct the cecal end of the lumen; or it may be that the first infection subsides and leaves a small ulcer which heals and causes a slight amount of contraction, and at the time of the next acute congestion or inflammation this portion of the lumen is already abnormally small and consequently the more easily obstructed.

The moment this portion of the lumen becomes completely obstructed a sudden increase in the infection is certain to occur, and this will constitute a real danger to the patient. Again, in many cases the appendix contains infected granulation tissue for a considerable period of time, which will be in a condition to at any time cause an obstruction of the lumen of the appendix and thus be favorable to the production of serious trouble.

Whenever an infection approaches the surface of the appendix the latter is likely to become adherent to the surrounding tissues, and this in turn results in an obstruction to the lumen of the appendix by causing short bends or kinks. At any given time this obstruction may become so complete that nothing will drain into the intestine, and then there is grave danger of gangrene of the organ from pressure as well as from interference with the circulation. There is the same difference between an infected appendix with free drainage into the cecum, and one in which this drainage has been obliterated, that we find in an acute abscess in any other portion of the body that is thoroughly drained and one in which no drainage has been established.

The increased pressure upon the tissues surrounding an abscess in any portion of the body will sooner or later produce pressure necrosis, and this probably accounts for gangrene of the mucous lining of severely distended appendices so frequently met with in relatively early operation in severe cases of acute appendicitis.

Condition of Appendix After an Acute Attack.

It seems most important to impress the clinical fact upon our minds that whatever the changes may be which occur in any given case as a result of acute or chronic inflammation of the appendix, the latter is rarely in as favorable a condition as regards the safety of its possessor after as before the occurrence of this inflammation. The change in its structure is almost invariably a reduction of some portion of its lumen, and this necessarily means a certain degree of interference with its drainage, and this in turn produces a tendency to the recurrence of an acute or chronic inflammation.

There are but two conditions in which the above course does not obtain: First, in the rare case in which a patient recovers from an acute attack in which the appendix is entirely destroyed, and, second, where the obliteration of the lumen begins at the distal end of the organ and progresses uniformly toward the cecal end. This is also exceedingly rare.

All of these results are impressed upon the surgeon more and more forcibly as his experience increases, and it seems as though their observation should lead to methods of treatment which would be more and more favorable to the patient.

There can be no doubt but that in a vast majority of cases a vermiform appendix which has once been the seat of severe inflammatory disturbance can never thereafter be perfectly normal.

At best, the normal appendix contains conditions very favorable for inflammatory disturbances from the fact that it is a blind, dependent sac with its open end communicating with the cecum, which normally always contains septic material.

Localization of the Disease.

While so much can be said against this organ, yet the more one comes in contact with it the more points will he find which seem favorable to the patient who possesses a diseased appendix if the latter is removed while the infection is still confined to its lumen. First, there is, with the exception of a few very rare instances, always a time in every case of appendicitis when all of the infectious material is confined to this organ and under conditions which are favorable to removal without appreciable interference with any other organ. Second, the appendix is in an accessible region. Third, it is easily located by following the longitudinal band upon the surface of the cecum in a downward direction until it is found. Fourth, its removal from the cecum is extremely simple and when once removed the cecum can be left smooth and without any denuded surfaces. In other words, after the appendix has been removed the patient is in no way physically impaired. This, however, is true only so long as the infection is still confined to the appendix itself, a condition which exists during the very beginning of an acute attack, and after a patient has perfectly recovered from an acute attack. This being the case, it seems logical to conclude that if a patient comes under care during a time when he is in this condition, it will be proper to relieve him of this useless and dangerous organ.

Time Limit of Local Infection.

In acute appendicitis no definite time can be given during which the infection is probably still within the appendix itself, but in severe cases this may usually be accepted as during the first thirty-six hours after the beginning of an attack. In mild cases this condition often obtains throughout the entire period of the acute attack. It is consequently important to use one's judgment, rather than to go by any number of hours, in determining whether the infection is still within the appendix.

It is quite important, however, to determine this fact, because if one can be certain thereof he can also be certain that with a reasonable amount of skill and experience in abdominal surgery all of the infectious material may be removed from the peritoneal cavity at once, leaving the latter in an exceedingly favorable condition for a speedy and permanent recovery.

The Determining Condition of the Immediate Operation.

All surgeons with extensive experience in the treatment of appendicitis at the present time seem to agree upon this one view: *That in acute appendicitis, in which the patient comes under the care of the surgeon during a time when the infection is still confined to the appendix, an immediate operation is indicated, provided a competent surgeon is available and the other conditions necessary for the successful execution of abdominal operations are within reach.*

This is true for the following reasons:

1. The patient is practically certain to recover.

2. He will be able to resume his occupation within a short time.
3. He cannot have a recurrence.
4. It practically eliminates complications, such as adhesions, metastatic abscesses, empyema, septic endocarditis, thrombo-phlebitis and peritonitis.
5. Drainage will be unnecessary, hence there is no danger of post-operative ventral hernia.
6. The infection of the pelvic organs in the female, with their serious consequences, as adhesions, dysmenorrhea, sterility, ovarian cyst, etc., will be avoided.
7. There will not be the serious digestive disturbances which are practically always present in patients suffering from recurrent appendicitis.
8. The amount of suffering will be reduced to a minimum.

Another reason which is commonly mentioned and which is not infrequently given in favor of an immediate operation, not only in this class of cases, but in all cases suffering from acute appendicitis, is the fact that we are supposed not to know what will be the outcome in any given case of appendicitis. This, however, is true only in cases in which the treatment before they come under care has been improper, and in which the future treatment is likely to be equally bad.

In any given case in which the treatment from the first has been proper, and in which it will be equally good in the future, we can predict with as much certainty as in any disease that we are called upon to treat just what the future will bring. This is true because of the peculiar position of the appendix and because of its environment.

The appendix is located in a secluded portion of the peritoneal cavity and it is surrounded, with the exception of the inner side, by relatively fixed structures. About it we find in front, the cecum; to the outer side and behind, the abdominal wall; below, the pelvic cavity; and only to the inner side have we the exceedingly movable small intestines. Aside from this we have the omentum, which is always ready to care for a diseased appendix by placing its folds about the latter and preventing septic material from infecting any of the surrounding structures.

Nature's Protective Influences.

Our observations have been convincing beyond a doubt that the tendency of Nature is to maintain a condition of rest, and thus to confine the infection to this secluded portion of the peritoneum. Our evidence for this conclusion lies in the following facts:

1. The ileo-cecal valve at once prevents the passage of gas and feces.
2. The nausea and vomiting results in the expulsion of at least a portion of the offending intestinal contents.
3. All of the available omentum collects about the appendix.
4. The contraction of the abdominal muscles over the appendix limits motion in this portion of the abdominal cavity.
5. The right thigh is frequently flexed to enable the contraction of the iliacus muscle behind the appendix.
6. Whenever the abdomen is opened in cases in which peristalsis has been inhibited early in the attack by making gastric lavage and then giving neither food nor cathartics by mouth, the appendix is found virtually surrounded by parietal peritoneum, cecum, cecal end of ileum and omentum, and thus it is prevented from causing trouble, even though it be gangren-

ous or perforated. Moreover, we have observed that when Nature is aided in carrying out this tendency to establish a condition of rest, it will result either in the absorption of any infectious material which may have advanced beyond the tissues of the appendix; or, if this be no longer possible, it will result in the formation of a relatively harmless, circumscribed abscess, which, if this condition of rest is maintained, will practically always either perforate into the cecum, or point toward the anterior abdominal wall where it may be drained easily and safely, or it will rupture into the rectum.

There are a few exceptions to this rule which should be mentioned here. In very emaciated patients with almost no omentum, and in young children in whom the omentum is often very slight, this organ occasionally fails to supply the necessary protection.

It should be stated at this point that circumstances have made it possible for us to observe an unusually large number of cases of appendicitis, which we have been able to follow through the acute attack and later been able to demonstrate the pathological conditions by removing the appendix. We should also state that in every case in which it was possible to obtain the consent of the patient we have removed the diseased appendix either during the acute attack, provided the patient's condition seemed to indicate that the operation could be performed safely; or if this was not the case, to remove the appendix in the interval at the conclusion of the acute attack.

Review of an Extensive Series of Cases.

During the past six years since the publication of the following statistics our results have improved very greatly for several reasons. 1. Our experience has been vastly increased and with this our judgment has improved in determining the conditions which in turn served as indications to details in treatment. 2. Practitioners in general do not at the present time give cathartics and food by mouth in these cases as they did formerly when almost every patient admitted to the hospital had previously received both cathartics and food by mouth. 3. We admit many more patients within the first forty-eight hours after the beginning of the attack. 4. Our operative technic has undoubtedly improved with these added years of experience. 5. The method of giving normal salt solution by rectum by the drop method has been of enormous value.

Instead of giving the newer statistics it has, however, seemed wise to repeat those of the period when our methods were on probation because the lessons from the blunders made during this period seem especially valuable.

In preparing the preceding edition of this work it seemed proper to make a general review of our clinical experiences in the treatment of appendicitis in the interval, because our position concerning this subject at the time the first edition appeared did not correspond with that held by other authors at that time.

In order to substantiate the opinion expressed in the first edition of this volume, we have reviewed all the histories of one thousand consecutive cases of appendicitis, which we operated at the Augustana Hospital during the thirty-three months from July 1, 1901, to April 1, 1904. During this period of time every patient suffering from appendicitis was admitted, at any time of day or night, without regard to condition, several of them dying almost immediately upon admission, and all such cases are included in these statistics.

Of the cases that were not operated only those who died were counted

in this series of one thousand, because in those who recovered from the acute attack, but were not operated, it was impossible to determine the exact anatomical diagnosis.

On the other hand, it was necessary to count the cases that died, but were not operated, seven in all, because the statistics would otherwise not be fair in comparison with those of other surgeons, who might have operated these fatal cases. We would say, however, that with possibly one or two exceptions these seven cases were quite beyond hope when they entered the hospital.

The number, one thousand, was chosen because of the convenience with which one can grasp statistics based upon multiples of ten. The last one thousand were chosen in order to indicate our present statistics. They were all taken from the Augustana Hospital records, because we have all of the cases at this institution under personal observation every day; while those operated at other hospitals we can observe less constantly.

CLASSIFICATION.

	Cases.	Deaths.	Mortality. Percent- age.
Chronic appendicitis or interval operations.....	540	3	.5
Acute appendicitis without perforation.....	255	5	1.9
(Of these six entered the hospital within thirty-six hours after beginning of attack.)			
Acute appendicitis, perforated or gangrenous, without abscesses	55	0	.0
(Of these five entered the hospital within for- ty-eight hours after beginning of attack.)			
Acute appendicitis, perforated with abscess.....	117	4	3.4
Acute appendicitis with diffuse peritonitis.....	33	10	30.0
	<hr/>	<hr/>	<hr/>
Total	1,000	22	2.2

Of the 255 acute appendicitis cases without perforation 200 were operated upon entering the hospital and 55 were treated by gastric lavage and absolute prohibition of food and cathartics of every kind by mouth, the nutrition being accomplished by means of small enemata. Of this class only six cases entered the hospital within thirty-six hours from the beginning of the attack.

There were 55 cases in which there was a gangrenous or perforated appendix, which were admitted before an abscess had formed. Of these there were five who entered within forty-eight hours after the beginning of the attack. Of the entire number 21 were operated at once and 34 were first starved until they seemed in a safe condition for operation. In most of these cases the appendix was completely surrounded by the omentum and held away from all other intra-abdominal structures.

Of the 117 cases of acute appendicitis, perforative or gangrenous, in which an abscess had formed, 39 were operated at once and 78 were treated by prohibition of all nourishment and cathartics by mouth until their condition seemed sufficiently improved to make the operation appear safe.

Of the 33 cases entering with diffuse peritonitis resulting from perforative or gangrenous appendicitis, all were treated at first with gastric lavage

and exclusive rectal feeding. Of this class a number should not have been admitted, because they were in a dying condition when they arrived at the hospital, but for fear of excluding any case which might recover, notwithstanding its apparently hopeless condition, we have made it a rule never to refuse a patient suffering from any acute non-contagious disease. This will account for what we believe is at the present time rather too high a mortality in diffuse peritonitis due to perforative or gangrenous appendicitis.

Among the 33 cases belonging to this class there were seven which were not operated, because they were in a dying condition when they entered the hospital or because from the time of admission to the time of death their condition was always such that, with previous experience with similar cases, operations had always terminated fatally. Still these cases were counted among our deaths, in order to include the entire mortality of all the cases treated.

It is plain that if these cases were eliminated and the cases added in which recovery followed non-operative treatment, our percentage of mortality would be reduced. We would thus have only 15 cases in more than 1,000, but this would not be absolutely fair, because it might be argued that the death in at least some of these seven cases should be attributed to an error in judgment, and that if even the apparently absolutely hopeless cases had been operated at once some of them might have recovered.

Five Hundred and Forty Cases of Chronic Appendicitis: Three Deaths.

In reviewing the histories of these cases we find many interesting facts. Among the three deaths in five hundred and forty cases of chronic appendicitis with interval operations, we find that one case, a weakly, unmarried woman, twenty-seven years of age, who had been ill much of the time during her entire life, had an acute attack of appendicitis two years before entering the hospital, and a second attack one year ago, since which time she had never been free from pain. At time of operation the appendix was found adherent, 13 cm. long, cicatricial at distal end, partially obstructed at cecal end, containing small amount of pus, pelvis secondarily infected, uterus retroverted and adherent, together with ovaries and tubes in pelvis. Tubes closed at distal end containing small amount of pus, removed, round ligaments shortened. No drainage.

Patient died four weeks after operation from exhaustion, probably due to absorption from raw surface in pelvis. Had this case been drained she would probably have recovered. This is undoubtedly also true if only the appendix had been removed. This was without doubt the offending organ, and it is believed that its removal would have resulted in a fair recovery, because the pelvic organs when secondarily infected usually show great recuperative powers after the obstructed, infected appendix has been removed.

Case 2. A married woman, thirty-six years of age, having suffered from puerperal infection after the births of two children, thirteen and fourteen years ago, each time lasting six weeks; had severe attack of acute appendicitis twelve and a half years ago, confining her to bed for three weeks. Since this time she has constantly suffered from subacute appendicitis.

At the time of the operation patient was in a greatly reduced condition. The appendix was club-shaped at distal end and almost completely occluded at cecal end, and contained several hard fecal concretions. This was removed and also both tubes and ovaries, which were adherent in the pelvis, probably as a result of the puerperal infection. No drainage was

established. The patient died on the fifteenth day after the operation from exhaustion. The same error in treatment accounted for the death of this patient as of the previous one.

In patients who have been greatly reduced by long-continued disease it is not wise to operate too extensively, and if this is done drainage should be used in order to relieve the patient of the burden resulting from the necessity of absorbing the secretion from denuded surfaces.

Case 3. In this patient, a woman thirty-four years of age, the chronic appendicitis existing for a period of nine years was complicated by double pyosalpinx. Both tubes, the right ovary and the appendix, were removed. The appendix was 18 cm. long, acutely flexed about its middle by an adhesion to the cecum. The distal end contained mucus and fecal matter.

The patient showed symptoms of intra-abdominal hemorrhage four hours after the operation. She was reopened hurriedly and it was found that the ligature upon the severely congested right broad ligament had cut through the ovarian artery and the patient succumbed to the loss of blood.

The husband of this patient was at the same time under treatment by a colleague for specific urethritis. It is consequently plain that the infection of the tubes was not due to the appendicitis.

This death was due to an avoidable accident.

The three deaths in this group would have been avoided had the operation been confined to the removal of the diseased appendix. The amount of disease found in the tubes seemed, however, at the time, to indicate their removal.

Ordinarily in similar statistics none of these cases would be included in deaths resulting from appendicitis operations because the appendicitis operation had no relation to the deaths, but in these statistics every case is counted in which the appendix was removed during this period of time even though the other disease for which the patient was operated at the same time was by far the more serious condition.

Acute Appendicitis Without Perforation: 255 Cases, 5 Deaths.

Case 1. Married woman, forty-eight years old, four pregnancies, two abortions. Has had many slight attacks of appendicitis during past five years, accompanied by severe pain, lasting from two to five hours. Last night had an attack more severe than any previous one. Suffers severe pain over region of appendix of a diffuse character when it commenced. Abdominal walls very thick, making palpation impossible. Operation at once, because it seemed likely that the infection would be found confined to the appendix. The appendix was found universally adherent behind the cecum, partly surrounded by the omentum. It was removed with difficulty, necessitating a considerable amount of manipulation of the cecum and the omentum. No drainage.

The patient died of peritonitis on the tenth day after the operation, probably due to the traumatism necessary in the removal of the deeply buried appendix, together with infection from the acutely inflamed organ.

Had this patient been starved during the acute attack and operated in the interval she would probably have recovered.

Case 2. This patient, an emaciated man forty-four years of age, entered the hospital at the end of an acute attack, which had not been very severe. He had suffered from recurrent attacks of appendicitis at various intervals for a period of about twenty years. The last three attacks had been more severe and he was unable to recuperate from them. Operated at once

and found a severely congested appendix, club-shaped at the distal end and constricted at the cecal end. It was universally adherent to the lower end of the cecum and the distal end, which contained a small amount of pus, was adherent to the anterior surface of the iliacus muscle.

The appendix was dissected out and the wound closed. The patient died on the seventh day from peritonitis. The autopsy showed a small amount of cloudy fluid in the pelvis. The infection had started from the tissues to which the club-shaped end of the appendix had been adherent, having evidently extended through the walls of the appendix during the late acute attack. This death could have been avoided by proper drainage. It is to be charged to faulty technique.

Case 3. Is interesting because quite unusual. A strong laborer, twenty-four years of age, had an acute attack of appendicitis one month ago which lasted one week. Within two days there had been a slight recurrence, but it seemed likely that infection was confined to the appendix.

The operation showed a congested, edematous appendix coiled upon itself like a snail, adherent between the lower end of the cecum and the mesentery of the ileum, obstructed at its cecal end and containing pus and feces in its distal end. Abdomen closed without drainage.

On the third day after operation there developed a pneumonia, which progressed in a mild form until the patient suddenly contracted a pneumococcus peritonitis, of which he died on the seventeenth day after operation.

The anesthesia had been started with chloroform, which was changed to ether just before beginning to operate and continued with ether throughout.

Pneumonia is much more likely to occur in cases wherein the alimentary canal has not been thoroughly emptied by a cathartic, hence it is likely that this patient would not have died had we waited to do an interval operation.

Case 4. A farmer, thirty-four years old, entered the hospital, giving a history of rather a severe acute attack of appendicitis one month previous, from which he had recovered in one week with the exception of marked tenderness and some pain over McBurney's point. His temperature was normal and his pulse sixty-six beats per minute. He was otherwise normal.

The appendix was universally adherent behind the cecum, was obstructed at the cecal end and contained bloody pus; it was nineteen centimeters long and its distal end reached nearly up to the liver. The denuded surface was covered with peritoneum and the abdomen closed without drainage. The patient died five days after the operation from acute peritonitis.

Drainage would have prevented this death. Dissecting out so long an appendix containing pus, before the acute attack had completely subsided, without instituting drainage, we think showed bad judgment.

Whenever there is the slightest doubt in any case about requiring drainage it should be the rule to drain. In other words, when absolutely certain that drainage is not needed, close without drainage; when in doubt at all, drain.

Case 5. A boy fifteen years of age became ill with typhoid fever eight weeks before, which lasted five weeks; was apparently well two weeks ago. Ten days ago developed slight fever and was confined to bed for three days; then he was apparently well until ten hours before he was brought to the hospital, when he developed excruciating pains over the entire ab-

domen, which became more severe in the region of the appendix. When the family physician was called he found the boy writhing in pain lying upon the floor. He immediately sent him to the hospital with a diagnosis of probable perforation of typhoid ulcer, with a possible diagnosis of acute appendicitis.

The patient was at once anesthetized with chloroform, then ether was given throughout the operation, which lasted but twenty minutes. The appendix was found edematous, congested, the size of a finger. It was removed. Its walls were very thick, its lumen was occluded at the cecal end by the edematous mucous membrane; the mucous membrane of the appendix was gangrenous in a number of circumscribed spots one centimeter in diameter.

The patient had uremic convulsions almost at once upon recovering from the anesthetic, which became more and more frequent, notwithstanding the use of hot air baths and transfusion of normal salt solution. Just before he was anesthetized he had a slight convulsion, which was supposed to be the result of his severe suffering, but which was probably uremic.

In this case the indications for immediate operation were so strong that it is doubtful whether one could have improved upon the treatment, but this is the only case in this group of five that probably could not have been saved with proper care, and even in this case, it may have been bad judgment to undertake operation so soon after his recovery from typhoid fever. Had we placed him on proctoclysis by the drop method and prohibited all nourishment by mouth, he would probably have recovered. In each one of the preceding four cases, the death was undoubtedly due to bad surgical judgment or bad technique.

CONCLUSIONS.

All of these patients were operated immediately upon entering the hospital because their condition seemed to indicate that the infectious material was confined to the appendix. Had these five cases been added to the fifty-five cases of this group in which gastric lavage was employed, and which received neither food nor cathartics by mouth, but were confined to exclusive rectal feeding, it is likely that three or possibly four might have recovered. This favorable outcome might also have been secured had drainage been instituted.

The total result of less than two per cent. mortality in this group of 255 cases of acute appendicitis is, of course, eminently satisfactory, but with the addition of the above criticism, it is believed that results in a corresponding group of the same number of similar cases we can look for a further reduction in the mortality. (This prediction was made more than six years ago and our experience since that time has proven the correctness of the statement.)

Acute Perforative or Gangrenous Appendicitis Without Abscess: 55 Cases, No Deaths.

The next group is especially interesting, because it contains fifty-five cases in which the appendix was completely surrounded by omentum and in which this protection was so effective that, notwithstanding the presence of gangrene or perforation, the infectious material had remained perfectly circumscribed. In all of these patients, without regard to the contemplated

treatment, food by the mouth and cathartics were prohibited at once upon admission to the hospital, gastric lavage was employed, exclusive rectal feeding was instituted and continued for one week or longer, in fact until they were normal as regards temperature, pulse and pain in the region of the appendix. Five of these cases entered the hospital within forty-eight hours after the beginning of the attack and were operated at once. Sixteen of the remaining cases seemed in a condition making an immediate operation safe and were operated at once. The remaining thirty-four cases were placed upon exclusive rectal feeding until their meteorism, pain and temperature had disappeared and their general condition had improved to the point at which it seemed safe to perform the operation. This occurred in most cases within four days after admission, while in others the interval was longer.

In this group of cases there is much danger of supposing that a wrong diagnosis had been made primarily, and that it would be safe to give at least liquid food and possibly cathartics as soon as the patient became apparently normal. We are certain that this error has cost a number of lives and has been responsible for many serious recurrences.

The condition is not as rare as one might suppose, as 55 cases in a group of 1,000 makes 5.5 per cent.

Acute Perforative or Gangrenous Appendicitis with Peritonitis and Abscess: 117 Cases, 4 Deaths.

All of these patients entered the hospital after the third day from the beginning of the attack. They had all received some form of food before admission, and most of them had received cathartics.

Quite a proportion of these cases stated that they had received no food of any kind, but when questioned specifically as to whether they had not received either milk or broth or soup, every one that had previously affirmed that no food at all had been taken admitted that one or the other of these forms of nourishment had been given them.

Many of these patients were received in a desperate condition, with what seemed at first to be diffuse peritonitis, severe distension of the abdomen, which was perfectly tense, nausea and vomiting. The slightest jar of the bed would cause severe distress. Many of them had a bad facial expression and seemed to be in a condition of shock with cold perspiration over the forehead.

It is in this class of cases that we formerly had a large mortality, which is still shared by all surgeons who operate at once in every case of acute appendicitis immediately upon making the diagnosis.

These were classed by Mynter as beginning diffuse peritonitis. Personally we had considered them as belonging to a class in which the primary diagnosis of severe peritonitis was incorrect, as proven by the fact that the abscess later became circumscribed; but a study of the excellent work of Moszkowicz seems to prove beyond a doubt that the peritoneum in these cases has a sufficient amount of resistance to change an early diffuse into a late circumscribed peritonitis.

Absorption of Poisonous Intestinal Products.

One very important point has not received sufficient appreciation here—namely, that the very bad general condition of the patient is greatly exaggerated by the fact that a great amount of decomposing substance is being absorbed from the stomach and small intestines, which would in itself suffice to make an otherwise perfectly healthy person extremely ill.

The excellent studies of Maury have demonstrated that this view is absolutely correct; that there is indeed secreted from the lining of the duodenum in these cases an exceedingly poisonous substance, consequently the benefit which we had demonstrated empirically, has now been confirmed scientifically. These patients give one the impression of having been poisoned so long as the decomposing substance remains in the stomach.

In these cases the localized inflammation in the region of the appendix prevents the elimination of the contents of the stomach and the small intestines through the rectum, and thus decomposition is greatly increased, as there is no natural drainage. In most of them we have found that just enough food is placed in the stomach, suited for decomposition, to produce the worst possible conditions. It would be as reasonable to suppose that a person would not be in danger of drowning if he were submerged beneath but a small amount of water, as to suppose that small amounts of liquid nourishment given by mouth are harmless, when one fully comprehends existing influences.

This is still further favored by the foolish idea that there can be nothing left in the stomach because the patient has vomited incessantly for a number of hours. In many of the cases where vomiting has continued persistently for hours we have removed great quantities of decomposing material, in fact, apparently enough to hopelessly poison a healthy person.

Upon removing this material by gastric lavage we have seen many patients improve in a remarkable way. Frequently the temperature will become normal, or nearly so, within forty-eight hours, the pulse reduced from one hundred and twenty beats, or more, to one hundred, or less, per minute. The nausea and vomiting will disappear after one or two, or at most three, gastric lavages, the tympanitis will be greatly reduced, and not uncommonly it will be possible to outline a swelling in the region of the appendix.

Probably it will never be possible to treat this class of cases entirely without mortality, but with the method we have employed the mortality has been reduced to less than 3.5 per cent. The deaths in this class occurred in the following four cases: (Since this was written six years ago our mortality in this class of cases has been reduced to less than two per cent.)

Case 1. A well-nourished man, thirty-two years of age, with a good history, with the exception of some apparently unimportant digestive disturbances, which were, however, probably referable to a chronic appendicitis, entered the hospital on the fifth day of an acute attack. Patient received no food from the beginning of the attack and no cathartics during the first two days; on the third and fourth days some liquid food was given, and on the fourth day a dose of calomel was administered. Patient did very well during the first two days, suffered a little more during the third day and became violently ill twenty hours after the administration of calomel.

On admission temperature was 103 degrees F. and the pulse 94. He suffered severe pain in the right inguinal region, the abdomen was severely distended with gas and a mass could be palpated in the right inguinal region. The patient's facial expression was bad and it seemed as though the peristalsis caused by the administration of the calomel had produced an extension of the previously circumscribed peritonitis, but as there was evidently an abscess present, immediate operation was performed.

An incision twelve centimeters in length through the right rectus abdominis muscle evacuated nearly a litre of foul pus. The abscess was freely drained with two glass drainage tubes and with iodoform gauze, without

making an attempt at removing the appendix. Death occurred three days later from peritonitis.

In this case it seems clear that the diffuse infection was due to the peristalsis caused by the administration of calomel on the fourth day of the attack. It may have been bad practice to operate at once, but at the time it seemed proper. This death must, of course, be charged to the murderous use of cathartics in acute appendicitis.

Case 2. A somewhat emaciated boy, fourteen years of age, entered the hospital on the twelfth day after the beginning of his attack. During the first six days the attack was mild and he received food by mouth. During the last six days he had received only a small amount of liquid nourishment by mouth. Temperature, 102.2 degrees F. Pulse, 100. Patient appeared very weak and ill, his abdomen was distended with gas. For the first five days after admission exclusive rectal feeding was employed and the infection became circumscribed in the right iliac region, reaching a little beyond the median line to the left. An incision ten centimeters long was made through the right rectus abdominis muscle. The appendix was found perforated at distal end. It was surrounded by the cecum, the ileum and the omentum. The perforation in the end communicated with an abscess containing several ounces of pus, which was carefully evacuated by sponging, then the appendix separated from its adhesions and removed, which in this case was undoubtedly the fatal mistake. The abscess cavity was drained. The patient died of peritonitis two days later.

Had we used better judgment in this case by simply draining the abscess and removing the appendix later on in the interval, the patient would probably have recovered.

The additional time consumed, the increased trauma and the exposure of abraded surfaces in a patient with slight resistance could scarcely have resulted differently. Furthermore, had this patient received neither food nor cathartics by mouth from the beginning of his attack he would undoubtedly not have lost his life.

Case 3. A boy six years of age entered the hospital on the seventh day of an apparently mild attack of acute appendicitis. During the preceding three years the patient frequently complained of colicky pains, followed by vomiting. These attacks never lasted more than twenty-four hours.

The patient had received liquid diet throughout the present attack. The right thigh was flexed upon the abdomen and in the region of the appendix a mass could be felt. The abdomen was moderately distended with gas, the abdominal muscles over the appendix were tense. Temperature, 101 degrees F.; pulse, 100.

The patient was placed on exclusive rectal feeding for forty-eight hours, when the abdomen was flat, the pain had disappeared except directly over the appendix. Temperature, 99 degrees F.; pulse, 90.

An incision six centimeters long through the right rectus abdominis muscle exposed an abscess containing about one ounce of pus and a thick, club-shaped appendix perforated at the end. The appendix was adherent to the anterior surface of the iliacus muscle and the abscess was completely surrounded by the omentum, cecum and ileum. The pus was sponged away without soiling any tissue, the appendix removed and the abscess cavity drained with iodoform gauze and with a glass tube.

The patient progressed normally for twenty-four hours, when he died suddenly without any apparent cause. An autopsy was not obtainable.

One can never hope to eliminate entirely such instances of death. The conditions appeared very favorable for a rapid and complete recovery and there seemed to be no reason for expecting a fatal result.

In one case of sudden death a number of years ago, after an operation for appendicitis in which the appendix was attached to the iliac vein, the result occurred from the loosening of a thrombus of the external iliac vein. It is possible that the same accident happened in the present case.

Case 4. A woman fifty-five years of age, who entered the hospital with a fistula of the cecum due to an acute perforative appendicitis, operated elsewhere three months previously.

The patient's condition was satisfactory after the operation, which consisted in the closure of a fecal fistula in the cecum three centimeters long. Five weeks after the operation, before the drainage wound had completely healed, but after the patient had been out of bed for one week, she suddenly developed gangrene of the right lung, from which she died a week later.

This condition undoubtedly resulted from an infarct due to a thrombus formed as a result of the disease or the operation, but we have been unable to trace the connection, as an autopsy was not granted.

Concerning the operations in all of these cases we have invariably endeavored to reduce the traumatism to a minimum. The surrounding peritoneal cavity has been protected with warm, moist gauze pads. All unnecessary manipulations were avoided. In case of circumscribed abscess the appendix was removed when it seemed as though this could be accomplished safely. The above histories show that several errors of judgment occurred in connection with this feature in this series.

Drainage was used whenever it seemed as though the peritoneum might not be capable of disposing of any infection remaining. In this again there were some fatal errors. It is much better to drain too often than to err in the opposite direction.

Irrigation was not employed in any of these cases because our experience has been less satisfactory when this means was frequently employed.

Reiteration of Cardinal Principles of Treatment.

It is, of course, impossible to go more fully into the histories in so large a series of cases without making the report unduly long and correspondingly tedious. We believe, however, that enough has been said to make it plain that experience with this series of one thousand consecutive cases, whose treatment was based upon the conclusions previously given, would justify us in urging others to make use of the same principles in treating similar cases.

To those who do not feel justified in subjecting their patients to a form of treatment of which they have not personally seen a practical application we would suggest that they continue to treat their cases precisely as they have up to the present time, but that immediately upon being called to see a case of severe acute appendicitis they carefully cocaine the pharynx by spraying with a two per cent. solution, then wait for five to seven minutes until the cocaine has had time to have its maximum effect. That then they introduce a stomach tube and remove any substance which may be present in the stomach by irrigating with warm normal salt solution. That then no food of any kind whatsoever, or cathartics, be given by mouth until the patient has been normal for four days, no matter whether or not an immediate operation be performed. The nutrition may in the meantime be

carried on by giving a nourishing enema, every three to four hours, consisting of one of the various concentrated liquid foods in the market, dissolved in three ounces of normal salt solution, through a catheter inserted into the rectum a distance of two to three inches.

We would suggest that this plan be followed in all cases in which the patients or their friends absolutely refuse an operation.

This plan has now been practised by a large number of physicians and surgeons, and all of those who have actually carried out the principles set forth in the above conclusions have found a very marked reduction in their mortality. We have received a large number of letters from physicians testifying to this fact, and many others have personally reported equally satisfactory results.

Our own experience and observation is borne out by many others to the effect that the administration of any form of nourishment or cathartics, or both, by mouth has caused an enormous number of deaths in patients suffering from acute appendicitis, and that its prohibition will save a correspondingly large number of lives.

We have been informed by many physicians that before this method was introduced in their practice they had many deaths from acute appendicitis and that now they almost never lose a patient from this cause. When we consider the effect this treatment has had upon the enormous number of these cases that have come under our observation at the Augustana hospital we readily comprehend these statements.

ACUTE GANGRENOUS APPENDICITIS.

Typical Case.

Patient, twenty-seven years of age, a bookkeeper by occupation, came under care one hour ago. He was then in his residence, a distance of two miles from the hospital, where he was seen in consultation with his physician, who had made the proper diagnosis before requesting consultation. The patient gives the following history:

Family history good. As a child he had suffered from measles, but was otherwise well. About one year ago he suffered an attack of pain in the right inguinal region, accompanied by vomiting and fever, and was confined to bed for about one week. Has been more or less constipated during the past year and has had more or less weakness and pain in the right inguinal region. This was always worse after having eaten heavily. One week ago he had a severe attack of pain, accompanied by vomiting and a slight amount of fever. He was confined to bed for three days. For the following four days he was up and about, and was fairly well this morning when he felt a slight pain before rising. He ate breakfast and at about ten o'clock was seized with most violent distress in the right inguinal region, accompanied by vomiting, chills and fever. Suffers from severe shock, is still having severe pain in the right inguinal region, although he received a hypodermic injection of one-half grain of morphia before coming to the hospital. In the region of McBurney's point there is great tenderness and the muscles are extremely rigid. His temperature is 100 degrees F. and pulse 102. There is no tumor palpable.

Diagnosis.

We have here again a fairly typical condition. A history of a previous acute attack of pain in the right inguinal region, accompanied by vomiting

and fever, which must have been sufficiently severe to leave the appendix somewhat impaired. It was not severe enough to warrant a diagnosis of gangrenous or perforative appendicitis, but it might have been due to an obstruction to the lumen of the appendix, resulting from the presence of an enterolith or an ulcer in the cecal end of the appendix. The slight attack a week ago might have been a repetition of the same condition.

At the present moment the patient is still suffering, but not nearly so much as one hour ago at his residence, where he was fairly in convulsions because of the extreme pain in the region of McBurney's point. The large dose of morphia he received before coming to the hospital serves to disguise the condition somewhat. This, however, does not matter, because there can be no doubt concerning the diagnosis.

The extreme violence of the attack which occurred about ten hours ago and which has not subsided since; the increase in his temperature; the acceleration of his pulse and the bad appearance of the patient; the great rigidity of his abdominal muscles; the obstruction to the passage of gas, all go to show that he is suffering from a gangrenous appendicitis, or an impending perforation due to pressure from an enterolith or the accumulation of pus in an obstructed ulcerated appendix.

Treatment.

Only two forms of treatment can be considered in a case of this character: 1. Immediate operation. 2. Palliative treatment according to the method employed in the previous case by means of exclusive rectal alimentation and consequent elimination of peristalsis.

Judging from the history here given and from the conditions we find upon examination it is reasonable to suppose that at the present time, only ten hours after the beginning of the attack, the infectious material is still confined to the appendix.

The following advantages may be brought forward in favor of an immediate operation in cases like the one before us:

1. The patient will almost invariably get well; it is an accident if he does not recover.
2. He will be able to return to work in one month.
3. He cannot have a recurrence.
4. He cannot have the complications resulting from progressive or metastatic infection.
5. There will be no adhesions with their digestive disturbances.
6. There will be no ventral hernia because drainage will not be required.
7. He will not become an invalid because of one or another of the possible complications.

It is quite different one or two or three days later when the infection has extended to the tissues beyond the appendix, because at that time we would have to expect trouble for the following reasons: 1. The patient is not certain to recover, even in the hands of the most skillful surgeons. 2. His recovery from the operation is likely to be slow. 3. It may not be safe to remove the appendix after opening the abdomen, hence a recurrence may still occur. 4. The operation may cause an extension of the infection. 5. Adhesions are likely to follow the operation performed at this time because drainage will probably be required. 6. For the same reason hernia frequently occurs after operations performed at this period.

What can we expect in case the patient is not operated immediately, but treated by the preceding method described?

In cases like the one before us, in which we have been compelled to employ this method because the patient or his friends absolutely refused an

operation, we have found the pain subside rapidly after employing gastric lavage and that the other symptoms decline within twenty-four or forty-eight hours, or at the latest seventy-two hours, with the exception of the tenderness upon pressure. In some cases a circumscribed abscess formed, which had to be opened externally or it ruptured into the cecum. If permitted to remove the appendix later it would be found eliminated from the general peritoneal cavity by means of adhesions to the omentum, the cecum or the iliacus muscle. If it was not removed later these patients usually had recurrent attacks of appendicitis.

We would consequently say in considering patients in the condition of the one just described that if a safe surgeon is available such patients should invariably be operated on at once for the reasons given, which will undoubtedly become more apparent as we proceed with the operation. It is for this reason that the family physician requested consultation with a surgeon as soon as he had made his diagnosis, and for the same reason we agreed upon sending this patient to the hospital the moment we had concluded the consultation. We have lost no time, for while the patient was on the way to the hospital all preparations for the operation were made here so that we could proceed at once.

Technique.

The patient is so tender that it will not be possible to prepare the field of operation before he has been anesthetized. We will consequently proceed with the anesthesia and then prepare the field of operation in the usual manner, being extremely careful, however, not to exercise a sufficient amount of force to complete an impending perforation of the appendix.

Incision.

It seems safe in this instance to make use of McBurney's incision described in connection with the previous case, because this will leave the abdominal wall least impaired after the wound has healed. Had the patient experienced several very severe attacks of appendicitis, it might be reasonable to suppose that much space would be required for the removal of the appendix, which could not readily be obtained through this incision. Should we find conditions more complicated after opening the abdominal wall than is to be expected from present indications we shall still be able to secure an increase in the size of the wound.

It is not likely that we will find an abscess outside the appendix directly underneath the abdominal wall, as this is usually accompanied by a condition of edema of the tissues composing the abdominal wall. Nevertheless, it is wise to be exceedingly cautious in making the incision through the transversalis fascia and peritoneum, in order to avoid injuring the underlying intestines which may be slightly adherent either from the attack the patient experienced a year ago or from the present attack, because frequently these adhesions precede the perforation. This process might have taken place during the slight attack the patient had one week ago.

Upon opening the peritoneum we see a tense, sausage-like object projecting forward between the ileum and the lower end of the cecum. It is surrounded entirely by a fold of omentum, being adherent apparently only behind to the cecum and with this to the iliacus muscle. There are no strong adhesions to the omentum, but this structure seems to be loosely agglutinated to the appendix by means of a delicate layer of leucocytic exudate. In strip-



PLATE XXIII

CONGESTED APPENDIX

Represents the vermiform appendix with a constriction near its cecal end. The mesentericolum extends a little beyond the end of the appendix. The latter is markedly edematous. Fig. B represents it laid open showing fecal concretions in its lumen, and also showing the constriction near its cecal end.

ping away the omentum there is no bleeding and neither the omentum nor the appendix is abraded.

Before attempting to remove the appendix we lift up the abdominal wall carefully and tampon the space around it with soft pads of aseptic gauze saturated with warm normal salt solution, in order to prevent contamination of the remaining portion of the abdominal cavity in case of rupture of the distended appendix. This leaves the other portions of the abdominal cavity virtually out of the field of operation, which is especially important in a case like the one before us, because we know that the appendix contains septic material and we must guard against its introduction into the abdominal cavity. Here we will carefully dissect up the appendix from its distal end, going very cautiously and grasping every bleeding point with hemostatic forceps as we proceed, and applying a fine catgut ligature each time in order to prevent mischief by pulling upon these forceps.

It is often much better to apply two pair of forceps to the cecal end of the appendix and then cut between these, thus severing the appendix from the cecum. Then hemostatic forceps are applied successively to the mesentericolum and this severed so far as caught in the grasp of the forceps with each successive forceps that are applied. In cases in which the appendix is adherent to the posterior surface of the cecum this method is especially useful in reducing the necessary manipulations.

The appendix is extremely tense, and half an inch from its distal end there is a greyish, dark, discolored point, a circumscribed gangrene. The mesentery extends to the end of the appendix, but is not free. Evidently the inflammatory disturbance of one year ago resulted in the adhesion which attached this mesentery to the lower end of the cecum and to the iliacus muscle. The mesentery is so short that it is not possible to grasp it with hemostatic forceps or to ligate it before cutting, hence it will be necessary to dissect loose the appendix and to grasp the mesenteric artery when it is divided. This is ligated directly and now we have the appendix free in the wound projecting from the lower end of the cecum, like a sausage, three and one-half inches in length and three-fourths of an inch at its greatest diameter. It is slightly curved upon itself and its walls are edematous. After surrounding the appendix with warm, moist gauze pads, in order to protect the wound in case of rupture, we apply two pairs of narrow, long-jawed forceps upon the cecal end of the appendix and cut between. From this point on the operation proceeds precisely as described in connection with the previous case, with the exception that a little greater care is exercised in applying the sutures in the cecum, because of the increased vascularity due to the acute congestion. Unless these stitches are applied carefully there is sometimes troublesome oozing from blood vessels which are at other times too small to be noticed.

An examination of the specimen removed shows that the appendix is completely occluded at its cecal end on account of cicatricial contraction due to destruction of its muscular lining which probably occurred during the attack a year ago. The appendix contains pus and mucus and a slight amount of fecal material in places. This serves to indicate that the cecal end of the lumen was not completely occluded until the beginning of the present attack. The muscular mesentery along the appendix is severely congested and dark and a small area of gangrene is visible at its distal end there is an area of about half an inch in diameter which is gangrenous. The edematous condition of

the tissues in the walls of the appendix is very apparent on the surface of the section we have made longitudinally through this organ.

It is quite plain that the removal of this organ must be the proper treatment in cases like the one before us, provided this can be accomplished safely, for the reasons which have been given, but it is equally plain that in such cases it would be an easy matter to infect the general peritoneal cavity, which would of course be a very serious accident.

This case has developed today with great severity, and still the conditions we found were favorable for the protection of the general peritoneal cavity against infection, had peristalsis been eliminated by the method described previously. The appendix was surrounded by the omentum which would have disposed of a great amount of infection and would at least have protected the general peritoneal cavity against infection. It is likely, then, that with this treatment even so violent a case as this would be in the worst instance, has resulted in a circumscribed abscess in the right inguinal region. It is for this reason that we believe laparotomy should be performed for the relief of acute appendicitis only when a safe surgeon is at hand and when the other conditions are such as to make a recovery fairly certain.

The conditions here and in many other similar instances which we have operated during the first thirty-six hours of an acute attack, show how extremely dangerous it is to encourage peristaltic motion of the small intestines by the giving of food and cathartics by mouth. Such action would probably have been followed by a perforation at the point at which the wall of the appendix was gangrenous and this would have been followed by the rapid distribution of the infectious material to distant parts of the peritoneal cavity. Had the gangrenous portion been toward the cecum a perforation would probably have taken place into the lumen of the intestine, which would have been favorable for the recovery of the patient.

Had we found it impossible to remove the appendix safely through the incision which was made in the present case the required space could have been obtained by cutting the outer edge of the fascia covering the rectus abdominis muscle, which would have made it possible to slide the inner portion of the edges of the internal oblique muscle apart a considerable distance. If this still failed to give a sufficient amount of space the internal oblique abdominal muscle could have been cut at right angles to the direction of its fibers, as shown in Plate XXVII.

Of course this incision may be lengthened indefinitely, although always done at the risk of weakening the abdominal wall to a great extent, because a muscle once cut at right angles to its fibers can never be restored to an absolutely normal condition, but circumstances may occur which make it necessary to do this in order to secure a sufficient amount of space to make the removal of an extensively adherent appendix possible.

If such a condition is anticipated it is, of course, much wiser to make the incision through the edge of the right rectus abdominis muscle, as this commands the field of operation equally well and the incision may be lengthened according to the necessities of the case, but if this has not been anticipated it sometimes, though rarely, becomes necessary to increase the space as indicated in Plate XXVII. Then the incision may be carried through the lower or the upper, or through both edges of the muscle, according to the direction in which increased space is desired for the safe removal of the appendix in any given case. If this has been done it is important to secure a

closure of the abdominal wound, which will prevent the formation of a ventral hernia.

In order to accomplish such a result we would suggest the following steps: Deep silk-wormgut sutures are first inserted through all layers down to, but not through, the transversalis fascia, as in Plate XXVIII. These stitches are left untied until the buried sutures have been applied, then they are tied over all, acting simply as stay sutures. The peritoneum and the transversalis fascia are next sutured with continuous catgut, great care being taken to secure as perfect coaptation as possible, because the transversalis fascia gives valuable support to the abdominal wall at this point and if properly united will aid greatly in preventing the occurrence of a ventral hernia. The transverse incision in the internal oblique muscle is next repaired, making it as nearly normal as possible, as shown in Plate XXIX. For this purpose we have used interrupted stitches of fine, chromicized catgut used double. Ordinary catgut might be absorbed before the muscle ends had been thoroughly united and the retraction of the latter, due to muscular contraction, would leave a point of weakness in the abdominal wall.

It is likely that in aseptic cases these muscles will unite very quickly. We have been compelled to enlarge the abdominal wound in this manner in only a few cases and in these the result has been perfectly satisfactory; but we have a great aversion toward any operation which contemplates the cutting of abdominal muscles at right angles and should not advise such an act except where the McBurney incision seemed to be the best at the time the operation was begun, but proved not sufficiently large to dispose of the conditions found after the abdomen was opened. The further steps in the procedure are the same as described in connection with the previous operation.

ACUTE APPENDICITIS WITH SECONDARY INFECTION OF PELVIC ORGANS IN THE FEMALE.

Typical Case.

The patient is a school girl, sixteen years of age; has always enjoyed good health, having grown up in the country. She menstruated at thirteen years of age, and was without pain until one year ago, when she suffered from a typical attack of appendicitis. Since then she has suffered severely during each menstrual period. She has had four typical attacks of appendicitis during the past year; the last one began one month ago and she is just now recovering. Her present condition is that of a very well nourished girl, evidently unusually strong and vigorous when in good health; tongue is clear; appetite good previous to recent attack, now absent; heart, lungs and kidneys normal. A slight swelling is perceptible over the region of the appendix, also slight dullness on percussion; vaginal examination cannot be made as patient is a virgin. She has been nauseated, but has abstained from food almost completely during this attack.

Class Characteristics.

This patient belongs to a class which is not at all uncommon. The characteristic feature lies in the fact that although the first attack was typical of acute appendicitis and the recurrent attacks were similar in character, there is in addition a dysmenorrheic pain, which is more frequently right-sided. The pain may be so high in the abdomen as to indicate a diagnosis of recurrent appendicitis with each menstrual period, but the fact that it oc-

curs regularly at this time usually results in a diagnosis of dysmenorrhea and is more commonly attributed to disease of the ovary and tube than to the appendix. The fact that menstruation was painless and normal previous to the primary attack of appendicitis, and that the patient is a virgin, would indicate that the disease must have begun in the appendix. It may still be confined to the appendix and the exacerbation may be due to the congestion incident to the changes present during the menstrual period. The close connection between the right ovary and tube and the appendix, due to the presence of the appendico-ovarian ligament of Clado, would readily explain the effect of this congestion upon a chronic appendicitis. We have repeatedly seen cases where the cecal end of the appendix was almost completely obstructed and the distal end thereof contained fecal concretions or pus or mucus in which the irritation or congestion due to the menstrual period seemed to suffice to cause a complete obstruction temporarily each month, and thus produce a mild attack of appendicitis without resulting in a disease of the ovary and tube.

In other cases in which the primary attack of appendicitis is severe enough to result in an infection extending beyond the vermiform appendix the conditions found are quite different. There may have been a perforation of the appendix and some of the septic material escaping from the immediate vicinity of the appendix into the pelvis may there have been taken up by the fimbriated extremity of the Fallopian tube, through which it may have been carried in the direction of the uterus by means of the ciliated epithelium lining this tube. The infection may have been sufficiently violent in character to destroy a portion of the lining of this tube, and thus have resulted in an obstruction, or an adhesion may have been formed between the fimbriated extremity of the Fallopian tube and the ovary, or between any of the other pelvic organs, or directly between the appendix and the Fallopian tube; all or any of these organs may have become adherent to the omentum.

Indications for Operation.

The increasing severity of the attack, and the fact that although the patient has recovered from the last seizure, she still has a perceptible mass in the region of the appendix, would indicate a sufficient amount of pathological change to warrant the removal of the diseased appendix. It seems, however, that the severe dysmenorrhea which has recurred regularly with each menstrual period since the first attack of appendicitis should be seriously considered.

This condition is undoubtedly due to the secondary involvement of the right ovary and tube. If the patient is not relieved of the cause of this severe suffering, which occurs at such short intervals, she will undoubtedly soon become a neurotic wreck, because she will soon be unable to recover fully from one attack before the beginning of the next one.

It is also likely that many cases of sterility result from the infection of the Fallopian tubes having its origin in an appendicitis; hence the sooner the latter condition is eliminated the greater the likelihood of averting such a result. This seems of sufficient importance to influence our plan of treatment of acute or recurrent appendicitis in young girls. The possibility of involvement of the pelvic organs, with their special complications, should demand the removal of the diseased appendix more imperatively than in male children.

We have also observed many times that these children were badly de-



PLATE XXIV.

ADHERENT APPENDIX.

Represents the cæcum together with the ileum and the mesentery of the latter. The appendix is bent upon itself in the form of an interrogation point. It is strongly attached by adhesions to the lower end of the cæcum. The lymph glands in its mesentery are greatly enlarged.

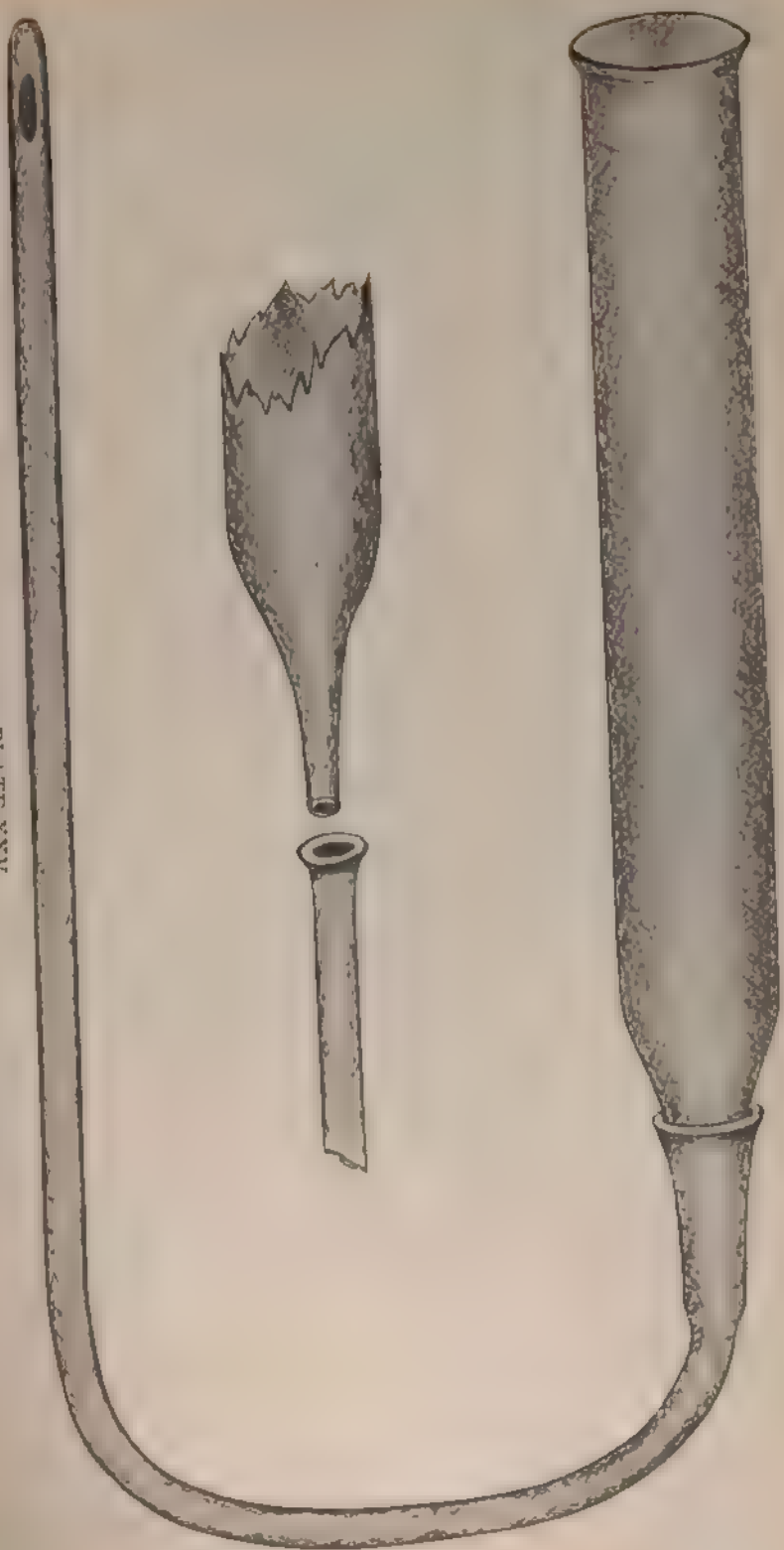


PLATE XXV.

GLASS SYRINGE ATTACHED TO SOFT RUBBER CATHETER TO BE USED IN RECTAL FEEDING.
Full size. The catheter is introduced a distance of two to three inches and the nourishment is poured into the syringe and permitted to enter by its own weight.



PLATE XXVI

ADHERENT APPENDIX

Represents the vermiform appendix bent upon itself making several sharp angles, held in position upon the lower end of the cecum by strong adhesions, one of the latter extending over upon the pleura. The end of the appendix is free. The mesentery is narrow, but it extends to the end of the appendix.

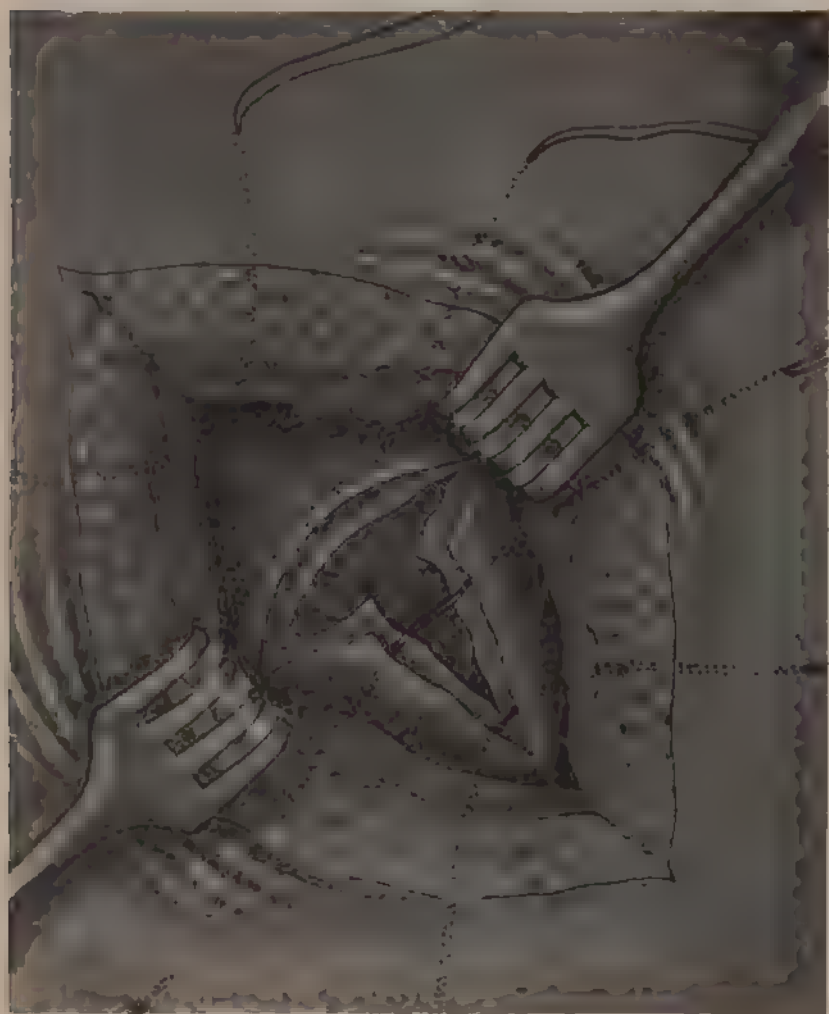


PLATE XXVII

ABDOMINAL INCISION

Represents McBurney's incision for the removal of the vermiform appendix, in which the internal oblique abdominal muscle has been cut transversely in order to increase the opening sufficiently to loosen an appendix adherent in the pelvis. This incision across the muscle is not desirable.

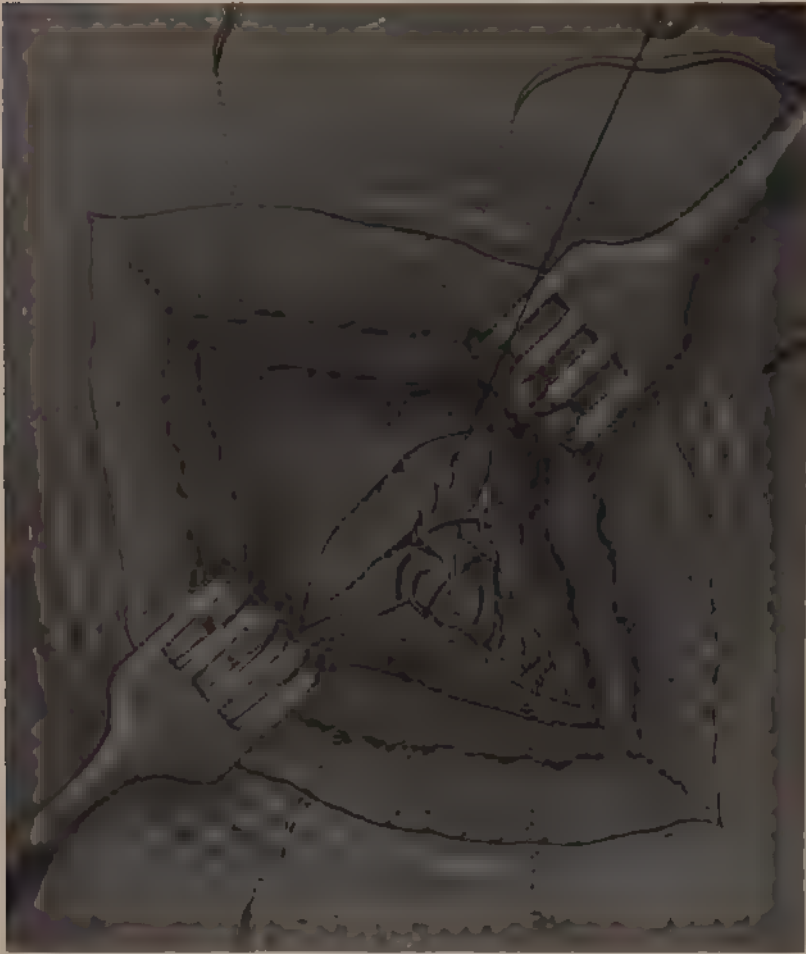


PLATE XXVIII

ABDOMINAL INCISION

Represents the method of closing the incision shown in Plate XXVII, the deep silkworm gut sutures grasping all layers down to the transversalis fascia, but being left untied until all of the layers have been united separately by means of cat-gut sutures.

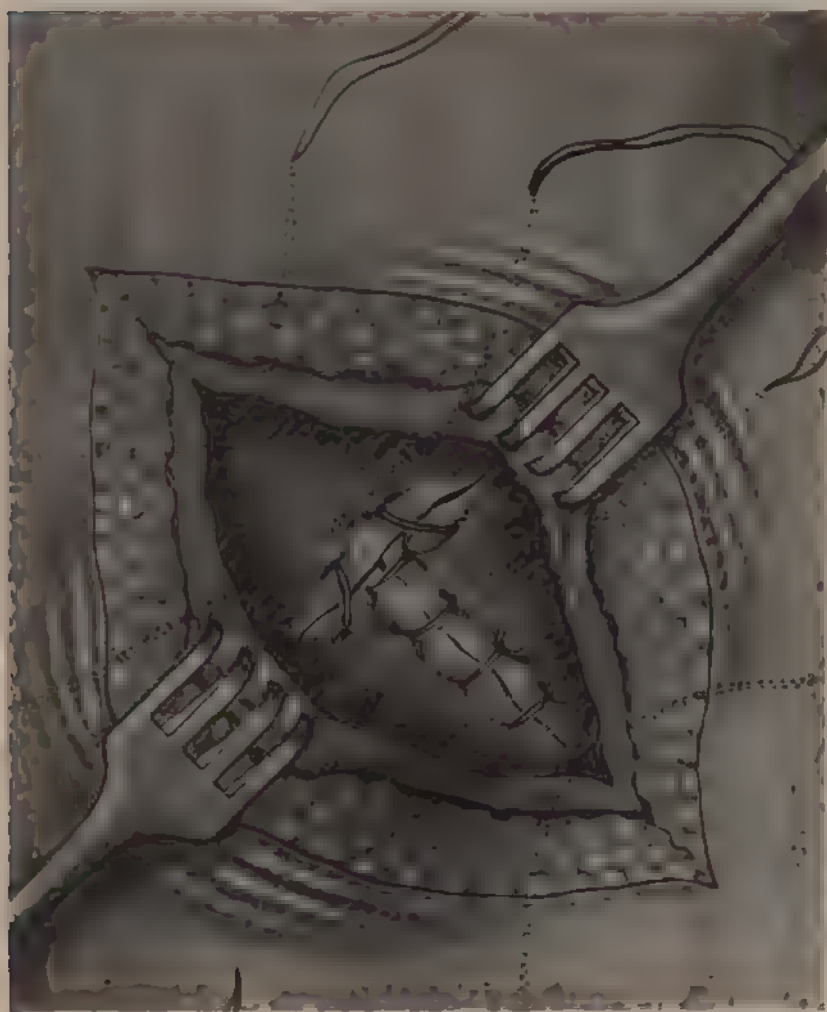


PLATE XXIX

ABDOMINAL INCISION

Represents the method of applying interrupted sutures in order to restore the internal oblique abdominal muscle in the same case the external oblique being held out of the way by means of retractors

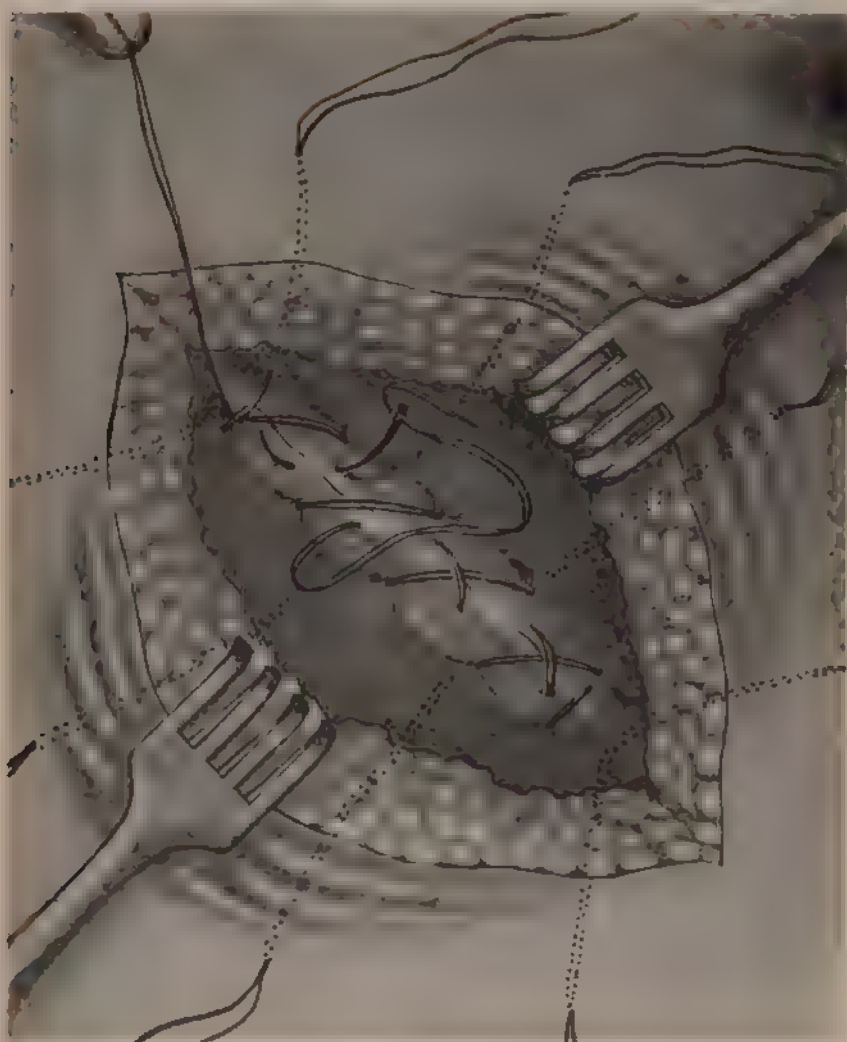


PLATE XXX

CLOSURE OF MCBURNEY INCISION

By suturing the fascia of the external oblique muscle separately, as indicated in this plate there is one strong layer which is perfectly restored which will compensate for a portion of the defect in the internal oblique as shown in Plate XXIX.

The deep silk worm gut sutures are drawn double. It is scarcely necessary to take this additional precaution, but the support from this source is undoubtedly of value until the injury to the internal oblique muscle has had time to become repaired. The deep sutures are tied after all of the layers have been separately united with cat gut sutures.

veloped physically and mentally when they came under care for the removal of an appendix which had been diseased to a slight extent for several years. The history would show that there had been little or no progress in the child's physical and mental development for several months or years. Many of these cases develop rapidly after removing the diseased appendix, often times gaining more in six months than they had in the previous two or three years.

In many ovarian cysts we have found the remnants of an appendix, once perforated or partly destroyed by gangrenous appendicitis. It is possible that the cicatricial tissue which formed upon the surface of the ovary because of the peritonitis in this vicinity secondary to the appendicitis may be responsible for the formation of some of these cysts.

The same is true of extra-uterine pregnancy, although in this condition there is more commonly a history of an infection of the Fallopian tubes through the uterine cavity.

Technique.

In this case it seems wise to make the incision through the outer edge of the right rectus abdominis muscle, as indicated in Plates XIII and XIV, because we may require a considerable amount of space through which to safely remove an extensively adherent appendix. Moreover, it may be desirable to remove the right ovary and tube if they are sufficiently involved to make their complete recovery to normal unlikely. This incision can be made as short as desirable until the conditions have been determined and then it may be lengthened upward or downward as indicated by the circumstances.

The mass which we were able to palpate through the abdominal wall consists of the omentum surrounding the appendix and the lower end of the cecum, and adherent to the lower end of this mass we find the right Fallopian tube, which is closed at its fimbriated extremity, and the ovary which is severely congested and twice the size of the left ovary, which is free and normal.

In order to prevent an infection of the surrounding portions of the peritoneum we tampon these away with a large piece of moist aseptic gauze. It is now one month since the beginning of the last attack, consequently the pus which may be present is not likely to contain any very virulent microorganisms. It is, nevertheless, wise to take the same precautions against an infection. We will now proceed to follow the longitudinal band on the anterior surface of the cecum as the most reliable guide to the location of the appendix, being careful to do as little mischief as possible in loosening the adhesions.

As we loosen the omentum a small quantity of pus is beginning to escape, which we sponge away with great care before there is any chance of causing an infection. The abscess contains about half an ounce of pus and a fecal concretion the size and shape of an olive stone, and the perforated appendix which is constricted at the cecal end and somewhat club-shaped at its distal end. We ligate the portion of the omentum which helps to form the abscess wall and treat the appendix as in the previous cases, after carefully separating it from its adhesions to the lower end of the cecum, to the anterior surface of the iliacus muscle and to the right ovary and Fallopian tube, which have been involved secondarily. When the perforation of the appendix occurred some of the pus evidently escaped into the pelvis and was taken up by the fimbriated extremity of the Fallopian tube, becoming

infected. The fimbriæ became adherent to each other and to the ovary, and to the lower end of the adherent mass.

Occasionally it is better to sever the appendix at its cecal end and to invert the stump and close the defect in the cecum as described in the previous operations, and then to enucleate the appendix, because in this manner the cecum may be pushed out of the way and more room gained, which will serve to facilitate the enucleation. The same method may sometimes be employed for the removal of an infected Fallopian tube and ovary, the enucleation being started from the uterine side, the tube being first severed at the uterine end and then enucleated from within outward.

In enucleating the inflamed adherent appendix it is important to bear in mind the fact that the appendicular artery, which is found in the remnant of the mesenterium of the appendix, is a vessel of considerable size, and that a fatal hemorrhage may occur if this vessel is not thoroughly controlled. The tissues are often so fragile that it is difficult to grasp this artery with hemostatic forceps without crushing it off and thus increasing the hemorrhage. If this fact is borne in mind, however, it is possible to grasp this vessel and ligate it safely.

Ordinarily, all of these steps may be carried out safely if the wound is made sufficiently long to permit the operation to be performed in plain sight; if the other portions of the peritoneal cavity are carefully tamponed away; if the appendix is located without unnecessary manipulations by using the longitudinal band on the anterior surface of the cecum as a guide and if the entire operation is performed without unnecessary manipulation.

With increasing experience each surgeon learns to recognize his own ability in these manipulations and can determine with a fair degree of certainty how much he can safely undertake to do in any given case.

It would, of course, be much better simply to drain the abscess and later to remove the appendix, than to do the thorough operation, if this seemed safer in any given case, because a second operation for the removal of the appendix could be very safely performed at a future time. This, however, must be left to the judgment of the surgeon who happens to perform the operation, as the point to be determined is not what is the best treatment for such cases in general, but what is the best treatment for the case under consideration with the skill and experience at hand. The general principle, however, is applicable to these, as to all cases in surgery, that, other things being equal, the more thorough the operation performed, the better.

Drainage.

Although we have removed this appendix, the infected omentum, the ovary and the tube without contaminating any other portion of the peritoneum, and although we have apparently removed all infectious material, the question whether or not it is wise to drain must still be considered. The fact that an abscess has existed makes drainage permissible. In our own work, we drain much less frequently now than in former years, yet when there is the slightest doubt in any given case we always drain.

Should we drain in this case through any portion of the abdominal wound which extends through the edge of the right rectus abdominis muscle a hernia would very likely result, because the connective tissue formed in the closure of the drainage opening would be very likely to give way. We consequently make a little incision one inch in length parallel to the fibers of the external oblique muscle two inches to the right of McBurney's point. This



PLATE XXXI

MEANS FOR PREVENTING SUTURE MARKS

If it is desired to avoid the occurrence of marks due to the cutting of deep sutures this can be accomplished by placing a roll of gauze directly upon the wound and tying the sutures over this as indicated in this plate. The same precaution against drawing the sutures too tightly must of course be observed if this method is employed as in tying the sutures in the usual manner.

The method produces more uniformly perfect results so far as the absence of an offensive scar is concerned than the subcuticular suture.



incision is carried through the fibers of the external oblique muscle down to the internal oblique, the fibers of which extend at right angles to the former. These are also separated and then a small opening is made in the transversalis fascia and peritoneum. Through this opening we carry a glass drainage tube, covered with one or more layers of iodoform gauze, to a point just below the cecum, from which the abscess was removed. What is left of the omentum is then carried over this surface and then the tampons are removed and the abdominal wall is closed in the usual manner.

After Treatment.

The drainage tube is removed any time between the second and the fifth day, and the gauze one or two days later, when the drainage wound is permitted to heal. Having been made without cutting any muscle fibers, this wound will never cause a hernia, because the edges of the split fibers will be drawn together as a result of muscular contraction, and thus the small opening will be efficiently and permanently closed.

For the first three days the patient will be sustained entirely by means of rectal feeding, nutrient enemata being given every four hours, as described before. If the patient is normal at the end of this time a moderate amount of liquid nourishment will be given by mouth at regular intervals, but if not normal at the end of this period the exclusive rectal alimentation will be continued. In case of pain morphia can be safely given, preferably by hypodermic injections so long as no food is given by mouth.

In a few cases we have seen both ovaries and tubes, as well as the uterus and bladder, involved secondarily in acute perforative appendicitis. The treatment must, of course, contemplate the relief of all of these complications.

Where it is apparent, before the abdomen has been opened, that both ovaries and tubes are secondarily involved, it is usually wise to choose the median incision, because from this the affected parts can all be reached, except when the appendix is adherent to the posterior surface of the cecum. However, we have never encountered one of these cases with a secondary involvement of both ovaries and tubes in which the diseased condition of these organs could not be recognized by a vaginal examination. In that case the median incision would, of course, be chosen.

In order to emphasize its importance once more, it is suggested that in all intra-abdominal operations performed for the relief of dysmenorrhea, especially if this is more strongly marked on the right side, it is wise to examine the appendix, because very frequently a diseased appendix is the sole cause of dysmenorrhea.

In one instance in which there was a free discharge of pus, filled with colon bacilli from the vagina, we found that the fimbriated extremity of the right Fallopian tube had grasped the gangrenous end of the appendix and that this end had never healed so that a continuous tube extended from the cavity of the cecum to the cavity of the uterus.

APPENDICITIS IN CHILDREN.

There are certain features in connection with appendicitis in young children which require especial attention, for if looked upon from the same standpoint as in adults our results will not attain the highest degree of satisfaction.



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APPENDICITIS IN CHILDREN.

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History.

Frequently a child that has been in most excellent health, whose general appearance indicates no disturbance, whose nutrition is good, and who is in no way suffering, suddenly develops a most violent attack of acute appendicitis. This can be explained in the following manner: The appendix in these children is usually large, but the cecal end is much the narrowest portion of the lumen. This favors the formation of an enterolith, which eventually either obstructs the cecal end of the lumen and brings about an acute appendicitis or it causes an ulcer, resulting from pressure necrosis, with the same ultimate result.

In many the mesentery of the appendix is very short, which still further facilitates necrosis of the portion projecting beyond the end of the mesentery, because in case of a thrombosis of one of the vessels in this portion there can be no compensatory circulation, while this can readily be established when the mesentery extends to the end of the appendix.

Diagnostic Error.

One peculiarity in appendicitis in children is the fact that the attack is almost always looked upon by the parents and friends, and frequently by the physician, as a case of violent, acute gastritis or enteritis, resulting from some indiscretion in eating. (In most cases the little patient has indeed eaten an unreasonable amount of some especially indigestible substance just before the attack began.) This is so common that one rarely sees these young appendicitis patients in whom the correct diagnosis was made from the beginning of the attack.

The omentum in young children is very small and not very substantial, hence it cannot be of as much use in separating the diseased appendix from the general peritoneal cavity as in the adult, and consequently it is necessary, in cases which come too late for an early operation, to watch closely from day to day, and if a circumscribed abscess forms to drain it.

Another difficulty encountered in the treatment of children is their fear of the stomach tube. It is important to employ gastric lavage, but many willful and badly brought-up children will struggle so violently against its use that even with cocain anesthesia one may not be able to accomplish the task without danger of injuring the patient because of the struggle required. By pinning the child into a large sheet which passes around the entire body from its neck to its feet and placing the child on its right side, it is usually possible to make gastric lavage safely.

To a slighter extent the same difficulties are sometimes encountered in rectal feeding.

The most important point, however, is in dispelling the idea that a severe pain in the region of the stomach in children, coming on after taking indigestible food, is due to gastritis and is consequently of little importance, because so often a careful examination will demonstrate it to be a gangrenous or perforated appendicitis. This condition frequently occurs in children not more than four years of age. We have seen a number of cases much younger, one as young as seven months, and the accompanying history of a case observed by Dr. W. B. Helm, of Rockford, Illinois, which is quoted because of its unusual interest, shows that it may occur in those still younger.

This patient, a boy three months old, was seen by Dr. Helm, January 5, 1902. He had suffered almost constantly since birth, crying much of the time, night and day. Frequent tenesmus, although bowels were easily regu-

lated. The mother's milk did not agree and various prepared foods were tried. The child took food ravenously, but never seemed satisfied. There was no gain in weight and some fever persisted most of the time. When the child was five weeks of age the local physician was called and detected a right oblique inguinal hernia. There was apparently no trouble in reducing it and he tried various forms of retentive apparatus. Still the crying, straining and fever continued. Seven weeks later the patient began to fail rapidly, and Dr. Helm found it with a temperature of 103° F. and pulse varying from 160 to 190. The child weighed only eight pounds and still cried most of the time. There was a hernial protrusion the size of a small hen's egg. The bulk of the mass could be readily returned, but a small object in the inguinal canal remained. It seemed like an undescended testicle, but both of these organs were found to be in the scrotum. Repeated trials failed to return it to the abdomen, so an operation was advised. On opening the canal the doctor found that the reducible portion was the head of the colon, and the irreducible part was the appendix, slightly adherent and greatly congested. He removed the appendix and closed the canal by the Bassini method. The pain was apparently lessened at once, the fever disappeared on the third day and the child gained two pounds during the first ten days and made an uninterrupted recovery. It seems as though in this case, judging from the history, the appendicitis may have been congenital.

In connection with appendicitis in children, we believe it would be best to lay down the rule that in every instance a child should be subjected to a careful physical examination when suffering from digestive disturbance, or from pain in the abdomen from any other supposed cause.

Many of these children give a history of perverted appetites and of feeling sick or nauseated after meals for some time before the acute attack.

APPENDICITIS IN OLD PEOPLE.

Fortunately it is but seldom that acute appendicitis occurs in those very advanced in years. We have seen one case of perforative appendicitis in a woman sixty-eight years of age.

In the treatment of these cases the fact that old people do not well bear confinement to bed in the recumbent position should be borne in mind. These patients should be placed in a semi-sitting posture in order to prevent hypostatic congestion of the lungs. If it seems at all safe it is well to operate these cases at once in order to shorten their confinement as much as possible. But these patients are usually very obese, which still further reduces their chances of recovery. It is consequently necessary in every given instance for the surgeon to choose between two evils, and the better his judgment the more likely he will be to choose wisely. If the operation be postponed it is well to reduce the amount of fat in the abdominal wall of obese patients by proper treatment and to remove the appendix after the patient has recovered from the acute attack. The method for reducing the weight in obese patients is discussed fully in another section.

COMPLICATIONS OF APPENDICITIS.

Any condition which may result from infection, either direct or metastatic, may result as an immediate complication of appendicitis. Of these the most common is circumscribed or diffuse peritonitis, with or without the

formation of abscess. This complication, as has been stated before, is greatly reduced in its importance if neither food or cathartics are given from the beginning, because this eliminates the mechanical distribution of infectious material by means of peristalsis. It also prevents the disturbance of septic thrombi, which may be present in the veins at the seat of inflammation, and which might be loosened were food and gas forced through the ileo-cecal valve; consequently metastatic infection is also greatly reduced in this way. Metastatic abscesses complicating acute appendicitis may develop at any point in the body and should be treated as though they had occurred in connection with the primary infection.

Many other complications may take place, because the presence of an acute or chronic appendicitis naturally does not preclude the occurrence of any other pathological condition which might be present in a patient not suffering from appendicitis.

Strangulated Hernia.

A considerable number of cases of acute appendicitis complicating strangulated hernia have been reported. We have encountered gangrenous appendices, both in strangulated femoral and inguinal herniæ, and in one case of irreducible umbilical hernia.

We have also operated upon one case of inguinal hernia which was complicated with suppurative epididymitis and orchitis, together with an acute suppurative appendicitis in a case of cryptorchism. In this case the cecum was so low that by lengthening the herniotomy incision upwards by dilatation it was possible to remove the appendix through this opening. An orchidec-tomy was performed, the wound drained and tamponed with iodoform gauze for a week, then it was sutured secondarily. The result was perfect.

Typhoid Fever.

In cities where typhoid fever is endemic it is not a very uncommon occurrence to find difficulty in making a differential diagnosis between typhoid fever and a mild attack of appendicitis, or between the presence of a perforative appendicitis and a perforated typhoid ulcer. In case the differential diagnosis between acute appendicitis and perforative typhoid ulcer cannot be made positively an abdominal section is indicated, because if the former condition is found, this treatment is proper while if the latter exists non-operative treatment would almost certainly bring about a fatal result.

The Widal test may be used for making a differential diagnosis, but if the patient has had typhoid fever at some previous time the Widal test will often be positive, and this will be misleading. Moreover it is often not wise to postpone operative treatment long enough to make this test. It is also to be borne in mind that the Widal test is applicable only to advanced cases of typhoid fever, hence, its value is greatly reduced.

In several instances we have observed patients suffering from plainly marked attacks of acute appendicitis in which a typical attack of typhoid fever followed immediately. In each of these cases the patient had consumed great quantities of infected water during the beginning of his sickness. The fever accompanying the appendicitis caused severe thirst, and the great quantity of water containing typhoid bacilli consumed during the time had undoubtedly brought about the typhoid infection.

We have, of course, seen many cases of simple appendicitis which had been diagnosed typhoid fever, and vice versa, but the cases referred to above did not belong to this class.

In some locations, especially in great cities, in which a large proportion of the population regularly drinks unsterilized water infected with typhoid bacilli, it is wise to bear in mind the fact that typhoid fever and appendicitis may occur at the same time in the same patient. Of course, the same thing might happen by accident with almost all of the other intra-abdominal conditions. We have personally encountered a renal calculus, an extra-uterine pregnancy, a gastric ulcer, as well as all the varieties of tumors occurring in the uterus and adnexa, in connection with acute appendicitis. It is likely that in each case the fact was due simply to a coincidence and that no causal relation existed between the two conditions.

Floating Kidney.

The presence of an abnormal mobility of the right kidney, either with or without general enteroptosis, is not at all uncommonly found in connection with chronic recurrent appendicitis. It is possible that the increased intra-abdominal pressure which has to be employed to overcome the obstruction to the passage of gas and feces through the ileo-cecal valve in these cases may be responsible for the mobility of the kidney, or it may simply be a coincidence.

In many there are extensive adhesions which interfere seriously with the fecal circulation, causing the intestines and the stomach to be constantly distended with gas, and this may help to account for the mobility of the kidney.

Thrombo-Phlebitis.

Occasionally in cases of appendicitis which have not been operated, and more frequently following operation, there is a thrombo-phlebitis of the external iliac vein. Ordinarily the condition does not materially interfere with the recovery. The same precautions should, however, be employed as in a thrombo-phlebitis from any other cause. If a small portion of the thrombus is displaced, it is likely to cause serious trouble and may even give rise to thrombosis of the pulmonary artery, causing sudden death. In this condition the greatest danger to the patient results from the fact that laymen are likely to rub or massage the affected part and thus may loosen a thrombus.

The part should be placed at absolute rest and under no circumstances should rubbing or massage be permitted over the affected area.

Pregnancy.

A complication which is usually mistaken for puerperal fever results from the coincidence of an acute gangrenous or perforative appendicitis with the delivery of a pregnant woman. We have personally observed a number of cases in which the differential diagnosis could not be positively made, but in four cases we were able to demonstrate gangrenous appendices at the operation, which should be made at once if a positive diagnosis can obtain, and it seems reasonable to add that if the absence of acute gangrenous appendicitis cannot be made with certainty, operation is justifiable.

DIFFUSE PERITONITIS.

Of all the complications of acute appendicitis the most dangerous is diffuse peritonitis. Moreover, acute perforative and gangrenous appendicitis and its treatment by the use of cathartics, together with the administration

of some form of food by mouth, or the operation of these cases after beginning diffuse peritonitis has become established, which occurs usually in severe cases from the second to the fifth day, have given rise to more instances of diffuse peritonitis than all other causes combined; hence it may be proper to discuss the subject at this point and to emphasize especially the steps required for its prevention.

PREVENTION AND INHIBITION OF PERITONITIS.

At the very beginning it seems important to emphasize the fact that treatment must be directed almost entirely toward prevention and inhibition of peritonitis, because this will reduce the mortality from this disease enormously. Physicians in general practice who have appreciated this fact have almost completely eliminated deaths from peritonitis in their practice, while others whose attention has been directed toward the cure of peritonitis have succeeded in reducing their mortality from this disease only to a very slight extent.

Prevention must depend largely upon a careful early diagnosis, and inhibition upon early treatment, in cases in which a circumscribed or a beginning diffuse peritonitis exists when the patient comes under the physician's care, by definitely planned methods which will prevent diffusing septic material from its circumscribed location to other portions of the peritoneal cavity.

There must, of course, always be a certain percentage of mortality because some cases will not reach the care of the physician until they are beyond the period at which prevention or inhibition is possible, but this class is constantly decreasing because physicians are becoming more thorough in examining their patients, and laymen are learning the importance of early intervention. There will also always be a percentage of mortality in cases in which the primary infection is overwhelming, as in some cases of perforation of gastric, duodenal or typhoid ulcers, or ruptured gall bladder, although in all of these early closure of the perforation, sponging away the extravasated substance and thorough drainage has reduced the loss from this source to a marked degree. Moreover, typhoid perforations are becoming very scarce in communities which are sufficiently civilized not to drink water infected with sewerage, and among those who will not permit their food to be infected by flies.

The mortality from peritonitis at the present time is by far greatest in cases in which the infection comes from the vermiform appendix and in those of puerperal origin.

Medical literature shows absolutely that there is no form of treatment of much use in peritonitis which is so far advanced that the patient is suffering to a marked degree from general sepsis. We might as well think of saving a wooden building after fire has partially destroyed all the walls and floors. It is unreasonable to expect good results under these conditions.

Our attention must be directed first toward prevention, which is possible in most cases, because peritonitis results from conditions which can be recognized and permanently relieved before they have given rise to peritonitis by making a careful physical examination in every case suffering from intra-abdominal conditions. A perforation of the gall bladder

is always preceded by gastric disturbances which should result in a physical examination, which, in turn, should establish a diagnosis of cholecystitis or cholelithiasis. An operation for the relief of this condition would prevent the perforation and peritonitis.

The same can be said of other conditions which later result in peritonitis.

Value of the Physical Examination.

No physician has a right to prescribe for the relief of any intra-abdominal condition without having made a physical examination.

The calamity which may follow the crime of a superficial examination in chronic cases, after weeks or months, may follow after days or hours in acute cases.

By giving something for the relief of indigestion in the chronic case, without a physical examination demonstrating the presence of a gastric or duodenal ulcer or gallstones, the physician may be responsible for the peritonitis which may occur weeks or months later as a result of perforation. Quite as certainly, by giving a cathartic for acute indigestion without a physical examination in a case of gangrenous appendicitis, he may cause a distribution of the infectious material over the entire peritoneal cavity by stimulating peristalsis, producing a diffuse peritonitis. This in turn may destroy the life of the patient in a few days. For a fairly trained diagnostician it is possible to recognize all of these conditions, whether they be acute or chronic, in time to prevent or inhibit peritonitis if he makes a careful examination when the patient first comes under his care. At the end of this chapter a number of conclusions will be found, which will contain the various elements to be considered in planning the prevention and inhibition of peritonitis. At this point the part played in the production and acceleration of peritonitis by the use of cathartics will be discussed more extensively. Undoubtedly, many patients lose their lives from general peritonitis because they were given either cathartics or food, or both, by mouth after the beginning of the peritoneal infection. In the very large number of cases which have come under our personal observation, there has not been a single instance of death from peritonitis in which neither cathartics nor food had been given by mouth after the beginning of the attack, which seems to be a most important observation.

The Introduction of Cathartics in the Treatment of Peritonitis.

Thirty-five years ago the phenomenal success in abdominal surgery experienced by Lawson Tait was attributed by many to the fact that he administered cathartics to his patients directly after performing laparotomies, and the fact that his patients regularly recovered without symptoms of peritonitis after ordinary abdominal operations performed for non-septic conditions, while other surgeons lost similar patients constantly from peritonitis at this period, led to the conclusion that cathartics prevent peritonitis. He says, in the Hastings essay for 1873, "The administration of laxatives within a few hours after the operation is becoming quite a common practice with me, this innovation, in my opinion, being possibly conducive in some measure to my increased success."

This theory that cathartics can prevent or inhibit peritonitis appeared very frequently in essays and in textbooks during the following quarter of a century, although, in the meantime, every surgeon had learned the fact

that the absence of peritonitis following Tait's operations was due to the circumstance that he was a clean, rapid surgeon, who neither infected his patients nor unnecessarily traumatized the peritoneum, and that because neither infection nor trauma were present, the cathartics he gave were harmless.

During these years many medical books and articles contained statements similar to the following referring to the treatment of acute appendicitis. It will not be necessary to quote from more than one of the best authorities who now never gives either cathartics or food in acute infection of any portion of the peritoneal cavity because, during this period, all of the best authorities, like Deaver, Murphy, Minter, Fowler, Morris, made similar statements in their books. "The bowel must be kept clean from irritating fecal matter, by enemata if possible, by a good cathartic if necessary." Evidence is not wanting of successful results obtained by medical treatment, especially in the use of saline purgatives."

Only patients in whom the infection was still confined to the appendix and those in whom the infection had been sufficiently circumscribed by strong adhesions to make dissemination of septic material impossible, which, according to the careful studies of Stanton, rarely occurs before the seventh day, furnished safe cases for this treatment.

At that time this surgeon's mortality in operations for appendicitis was almost 10 per cent., and since prohibiting all forms of food and cathartics by mouth, and giving normal salt solution by rectum, his mortality has been reduced to less than one-fourth of this percentage in precisely the same class of cases.

Mode of Action of Cathartics.

In cases in which the primary infection comes from a circumscribed point like the appendix, or a leaking pus tube, or a nearly perforated gastric, duodenal or typhoid ulcer with slightly adherent omentum covering the point of danger, the conditions are fair for obtaining a circumscribed instead of a diffuse infection. The same is true in case of a gall bladder with a gangrenous mucous lining.

In case of the appendix and the Fallopian tube, the cecum, sigmoid and the omentum are likely to confine the infection to the pelvic portion of the abdominal cavity. In all of the other instances the burden of the work of protection falls upon the omentum, but so long as the infection is in one circumscribed location, the entire free portion of the omentum can and will arrange itself about this point and will prevent the infectious material from passing on to other portions of the peritoneum. All of the physiological forces become active to prevent the escape of this septic material to other portions of the peritoneal cavity. The colon becomes filled with gas and acts as a cofferdam. The small intestines, if not disturbed by cathartics or food, form an embankment about the diseased area.

These conditions have been observed innumerable times by surgeons who have operated in acute cases.

The nausea prevents the patient from taking food unless this is forced upon him by some foolish friend or unless it is prescribed by some incompetent physician.

The abdominal walls become rigid and form an anterior splint. Everything is as favorable as can be for the process of repair, which consists in the concentration of the activity of millions of leucocytes in the infected area

and the production of antibodies in the blood and the limitation of nutrition of the septic micro-organisms to an area in which they will soon become reduced in virulence.

It is true that the alimentary canal may contain septic material, but this will soon be excreted through the stomach and can be readily removed by the use of gastric lavage. If no further food of any kind is given by mouth, the small intestines will soon be free from septic material, and gastric lavage applied once or twice will usually suffice to remove the septic material excreted into the stomach, although in rare instances it is necessary to repeat this lavage several times a day for several days.

Were one to continue placing food in the stomach during the progress of the disease, then there might be some doubt as to the choice between the two evils of leaving a quantity of decomposing substance in the alimentary canal to poison the patient, or forcing it out by means of a cathartic and incidentally killing the patient by carrying the septic material from this circumscribed area to the other peritoneal surfaces by the peristalsis caused by the cathartic.

Since it is possible to supply the necessary amount of nourishment by rectal alimentation and a sufficient amount of fluid by the continuous normal salt solution introduced by the drop method into the rectum, according to the system originated by Murphy, or by any one of the numerous methods which have been described by others, there is no reason why one should risk harm by introducing food or cathartics by mouth. No good can come from it because it is not needed. That harm does come from it is not only plain from the theoretical reasons, but has been demonstrated in hundreds of cases.

This applies to all cases without regard to the form of surgical treatment that may be chosen in any given case.

Whatever surgical treatment may be contemplated in case of any form of existing peritonitis, the results must be better if the infection is not diffused by peristalsis. There can, therefore, be no reason why peristalsis should be initiated by the use of cathartics. Even the smallest amount of cathartic may change a harmless circumscribed infection into a serious diffuse peritonitis.

One demonstrable change consists in the rapid increase in leucocytosis even after the administration of a small amount of cathartics. One-tenth grain of calomel with one grain of soda may increase leucocytosis several thousand within a few hours, and the same is true of other cathartics and also of enemata, except when given by the drop method. We have had an opportunity to observe this in a hospital whose beds are open to the general practitioners of the community in which it is located. Some of these practitioners give cathartics habitually as a form of initiative treatment while they are trying to think what form of treatment is indicated. This has given us an opportunity to study the effects of cathartics upon the leucocytosis in these cases.

A former assistant, Dr. John L. Yates, has proven conclusively, by a large series of experiments upon animals, that infectious material is rapidly diffused by the administration of food or cathartics, because of the establishment of peristalsis. Injecting lampblack into the abdominal cavity, he found that this remained in a circumscribed location so long as the intestines were at rest; but upon the administration of cathartics it is rapidly

diffused over the entire peritoneal cavity. The same was true of septic material introduced in the same manner.

Constipation is looked upon rightly as a cause of ill health; consequently it is but natural that, counting upon the law of probabilities, a physician or a layman who gives a cathartic in every case, with or without having previously made a diagnosis, will have fair results in most patients who are not suffering from peritonitis. Moreover, in cases in which there is not as yet a circumscribed peritonitis, especially in catarrhal appendicitis, the patient feels better after the use of a cathartic and, as there is no septic material present to be diffused throughout the peritoneal cavity, no harm can come to this class of patients.

If one can be absolutely certain, therefore, in any given case, that there is no circumscribed infection, a cathartic can, of course, be given safely in that case. If no harm comes from it, the diagnosis has been confirmed, but whenever there is the slightest doubt it would be foolish to take such a risk for the sake of confirming a diagnosis. As a general rule it may be stated that in all doubtful cases, even if the doubt be ever so slight, a cathartic should never be given because in the given case in which it is harmless it is not needed, as the bowels will be spontaneously evacuated, and in the other cases cathartics are contraindicated.

That a cathartic is safe in only a very small percentage of cases was proven by Murphy's statistics of 1895, which showed that in 94 per cent. of cases of acute appendicitis pus was found outside the appendix at the time they came under treatment. It is plain that the 6 per cent. in whom the infection is still confined to the appendix will all recover under proper surgical treatment, and the 94 per cent. in whom the infection is already beyond the tissues of the appendix must be exposed to great risk if peristalsis is caused by the administration of cathartics.

Effect of Cathartics in Cases of Mechanical Obstruction of the Intestine.

However harmful it may be to administer cathartics in cases suffering from circumscribed peritonitis, it is still more harmful to administer these remedies in cases suffering from mechanical obstruction of the intestines, no matter whether this be due to strangulated hernia, volvulus, Meckel's diverticulum, constricting bands of adhesion, intussusception, kinking of the intestines, impacted gallstone, impacted submucous lipoma or fibroma in the intestinal wall or obstruction due to malignant growths in the intestinal wall or pressing upon it from the outside.

In every case in which there is even a suspicion of mechanical obstruction of the bowel, gastric lavage should be instituted at once and absolutely nothing should be given by mouth.

The intestine above the point of obstruction suffers so severely as a result of the pressure from the peristaltic action caused by cathartics that the walls become permeable to the passage of septic material, which is proven by the presence of micro-organisms in the peritoneal fluid, and the mortality is at least four times greater in cases that have received cathartics than in those that have received none. In many cases the intestine may even be perforated above the constriction as a result of the use of cathartics. All of these conditions we have encountered many times in practice.

Puerperal sepsis and post-operative sepsis must, of course, be eliminated by proper prophylaxis.

Although convinced that abstaining from the use of cathartics alone in cases of incipient peritonitis is the most important means of inhibiting this disease, still we believe that it is most important to bear in mind all of the following conclusions and that, when these have been thoroughly applied in practice, deaths from peritonitis will be almost entirely eliminated. These conclusions are quite as applicable to cases which are treated surgically as those treated without surgical intervention.

It would be most unfortunate if, by directing attention particularly to the harmful effects of cathartics in peritonitis, this section should lead especially the general practitioner to think that this is the only dangerous form of treatment, because the errors pointed out in the following conclusions have also destroyed an enormous number of human lives, and by constantly keeping them in mind any general practitioner can reduce his mortality decidedly.

Conclusions.

1. A careful physical examination should always be made in patients suffering from gastric disturbances, nausea, vomiting, gaseous distention or pain in any portion of the abdomen, so that an early diagnosis can be made. In acute cases violent manipulations are dangerous and not necessary during examination. They may cause a diffusion of septic material.

2. A diagnosis of chronic appendicitis, gastric or duodenal ulcer or gallstones should be made through a careful study of the history and physical examination, and relieved by proper treatment before a perforation is possible.

3. Patients suffering from intestinal obstruction, whether this be due to strangulated hernia, constriction by bands or adhesions, volvulus, intussusception or kinking of intestine, Meckel's diverticulum, gallstone or carcinoma, should be operated at once and they should never, under any circumstances, receive either cathartics or food by mouth after this condition is even suspected.

4. Gastric lavage should be employed in these cases at once and again immediately before operation, and it is well to leave the stomach tube, preferably the form invented by Kausch, in the stomach to drain out any intestinal fluid which may regurgitate during the operation. Many of these cases can be operated under local anesthesia.

5. Opium in any form should never be given before a diagnosis has been made, and never in the presence of any form of peritonitis, unless gastric lavage has been done, and the introduction of every form of nourishment and cathartics by mouth is absolutely prohibited. This applies to even the simplest forms of liquids, like beef tea or broth, and also to the use of champagne and other stimulants.

6. This applies quite to the same extent to post-operative treatment.

7. In military surgery it is most important as a prophylactic measure that soldiers enter the firing line with empty stomachs and intestines.

8. Abdominal wounds made during battle, with large objects like splinters from shells, indicate immediate operation.

9. Abdominal wounds inflicted in battle by small calibre bullets, in the absence of hemorrhage, should be treated by absolute rest; not even water should be given by mouth.

10. An exception should be made in cases which can be in the hands of the operating surgeon with satisfactory assistants and facilities within two hours after the injury. Under these conditions an immediate abdominal section is indicated.

11. Gastric lavage should be done at once in every patient suffering from any form of peritonitis, except from stomach or duodenal perforation, if nausea or vomiting or gaseous distension is present, no matter what other form of treatment may be contemplated.

12. No food of any kind whatever and no cathartics should ever be given by mouth in the presence of peritonitis, no matter what other form of treatment may be contemplated.

13. Even water by mouth should be prohibited until the patient is well on the way to recovery.

14. Instillation of normal salt solution by the drop method, by rectum, as introduced by Murphy, or by some other safe non-irritating method, is one of the most valuable means of inhibiting peritonitis. It is well to give normal salt solution continuously from one to two hours and then to interrupt this treatment for two hours.

15. In rare cases in which this method cannot be employed, normal salt solution should be given subcutaneously in quantities of 500 to 1,000 ccm. sufficiently often to overcome thirst and keep the blood vessels filled.

16. Large enemata, except by the drop method, should never be given in the presence of peritonitis.

17. In order to prevent post-operative peritonitis, it is important never to traumatize the intra-abdominal organs unnecessarily during operation.

18. Much less handling of the intestines is necessary if these are not distended with gas, a condition which can best be secured by giving the patient two ounces of castor oil on the day before the operation, but this should never be given in the presence of even the slightest amount of peritonitis of any form.

19. Gastric lavage following abdominal section often prevents incipient peritonitis from progressing by inhibiting peristalsis; it should always be employed in the presence of nausea or vomiting or gaseous distension. In order to prevent gagging, it is well to spray the pharynx thoroughly with a 2 per cent. solution of cocaine ten minutes before the stomach tube is introduced.

20. In acute appendicitis the appendix should be removed before the infection has extended beyond the organ. If conclusion No. 1 is adhered to, this can be done in almost every case with almost perfect safety, because the patient can then be placed in the hands of a competent surgeon within thirty-six or forty-eight hours from the beginning of the attack.

21. In subacute and chronic appendicitis the appendix should be removed before it has an opportunity to cause an acute attack.

22. In acute appendicitis which has been carried through an attack without an operation, it is well to confine the patient absolutely to a liquid diet until his appendix has been removed.

23. In cases of acute appendicitis, either perforative or gangrenous, which have received some form of food or cathartics after the beginning of the attack, which reach the care of a surgeon too late for a safe early operation and are suffering from beginning diffuse peritonitis, gastric lavage, absolute abstinence from food and cathartics by mouth and the slow instillation of normal salt solution by rectum are indicated.

24. This will result in the increase of resistance against infection to such an extent that 97 per cent. of these cases of perforative or gangrenous appendicitis can later be operated with safety.

25. Feeding should be entirely by enemata, preferably consisting of one ounce of a commercial concentrated liquid food dissolved in three ounces of normal salt solution given slowly every three or four hours through a small rubber catheter introduced into the rectum not more than three inches.

26. From ten to thirty drops of deodorized tincture of opium should be added to each rectal feeding, until there is no longer any pain.

27. Placing these patients in the Fowler position greatly increases their safety.

28. The application to the abdomen of a large, hot, moist dressing of equal parts of a saturated solution of boric acid and alcohol greatly increases the comfort of these patients and prevents harm from manipulations.

29. It is important for the general practitioner and the general public to become familiar with the danger of giving any kind of nourishment or cathartics by mouth in the presence of impending peritonitis from any cause, and that this applies to milk, broth and other forms of liquids and even to water.

The repetitions in these conclusions are intentional because it has seemed worth while to cover every possible point so completely that no one taking the time to read these conclusions carefully could be in doubt. As stated before, these conclusions are all based upon the observation of a very large number of cases and they are not in any way theoretical as they all have an intensely practical foundation.

TUBERCULAR PERITONITIS.

Typical Case.

The patient is a married woman thirty-two years of age, giving the following history:

Her father died of pulmonary tuberculosis at the age of fifty. One sister died from the same cause at the age of thirty. Another sister is suffering from the same disease at the present time. The patient had measles as a child but otherwise has had good health. Her menstruation began at the age of fifteen and was regular but somewhat painful. She married at twenty-two; has had five normal pregnancies. She has suffered from constipation during the past ten years. The abdomen has been distended for several years and she has suffered from eructations of gas. About four months ago fluid was first discovered in the abdominal cavity. She was then put to bed and received internal treatment, but the accumulation of fluid in the peritoneal cavity has constantly increased. In the meantime she has lost ten pounds in weight. She has occasional pains in the left side of the abdomen, lasting a few hours at a time. The abdomen is enlarged to the size of a six

months' pregnancy, but is flattened and there is a prominence of the umbilicus.

The patient is sufficiently nourished; her tongue is clean; the appetite fair; bowels constipated; heart, lungs, liver and kidneys normal; her temperature is normal; pulse is 80, regular and fairly strong; abdomen is distended and tympanitic. A rather hard mass is felt in the right side of the abdomen opposite, and a little below, the umbilicus; slightly movable, but does not move with respirations. Her right kidney is movable. There is dullness upon percussion, with the exception of a small area over the most prominent part of the abdomen. The area of dullness changes with a change in her position. Upon vaginal examination the uterus is found bound down by a solid mass in the pelvis.

This history, together with the physical examination, would indicate the presence of a tubercular peritonitis with fluid in the free peritoneal cavity. The fact that the heart, liver and kidneys are normal would indicate that the fluid contained in the peritoneal cavity must be the result of a local irritation. This might be due to the presence of a papilloma originating from the ovary, but that would scarcely account for the mass in the upper portion of the peritoneal cavity, which is probably the result of adhesions between the omentum and the intestines, due to abdominal peritonitis. It is not difficult in this case to differentiate between this condition and the presence of an ovarian cyst, because the abdominal cavity is not so thoroughly distended as to make all portions dull upon percussion, nor are the small intestines so completely agglutinated by tubercular peritonitis as to be held away from the circumscribed accumulation of ascitic fluid, making a resonant area above or to the side. The tubercular family history would make a tubercular infection especially likely, although many of these cases obtain their infection from food. Most of these patients have at least a little elevation of temperature in the afternoon or evening, or a subnormal temperature in the morning, and if careful record of this patient's temperature had been taken throughout her period of sickness, we are confident that this condition would have been found at some time. Even at the present such a variation in temperature could undoubtedly be established within a week or two by taking the temperature regularly.

The diagnosis can be confirmed by using the tuberculin test or by applying the test introduced by Von Pirquet, but in cases as clear as this one these additional tests are not necessary. The latter is absolutely harmless, hence there is no reason why it should not be used in every instance. The tuberculin test when cautiously applied so rarely does harm that in the event of doubt, it is always well to employ it, as it is somewhat more reliable than the other.

Treatment.

This patient has been under constant treatment during the past four months by a careful and competent physician. The treatment consisted of hygienic measures, of rest in bed, of intestinal antiseptics, and she has been given good, wholesome food, care being exercised that the milk, and all the other food which might possibly contain tubercle bacilli, was carefully sterilized before use.

An incision three inches in length is made in the linea alba below the umbilicus. This at once permits a large quantity of thin, slightly-yellowish fluid to escape, leaving the peritoneal cavity studded with tubercles through-

out, the intestines and omentum being somewhat adherent in the upper portion of the peritoneal cavity; the cecum and appendix to the right being covered with the same small tubercles, the uterus, ovaries and tubes, and the sigmoid flexure, forming a mass in the pelvis also covered with tubercles. The peritoneum is one-eighth of an inch in thickness, somewhat purplish in color and completely studded with tubercles.

After carefully sponging away all of the free fluid with moist aseptic gauze pads, exercising great care not to cause any abrasions by the manipulations, a large glass drainage tube covered with four thicknesses of formidin gauze is placed into the cul de sac and permitted to project through the lower angle of the wound, then the abdominal wound is closed.

It is doubtful whether, in a patient like this it is better to close the abdominal cavity at once or to insert a drainage tube surrounded with iodoform gauze, as previously described. In case the latter method is chosen the tube and gauze should be removed as soon as the drainage has ceased.

In following the experience of a number of surgeons who invariably drain these cases, and others who close the abdominal cavity without drainage, it has seemed that the former have much fewer recurrences than the latter. This has also been our personal experience, so that we now drain invariably in all cases in which we operate for the relief of tuberculous peritonitis.

Medical vs. Surgical Treatment.

At the present moment the treatment of tubercular peritonitis seems to drift back into the hands of the practitioner of internal medicine, after having been virtually considered a surgical disease. Until very recently, and for a period of more than ten years, surgeons were generally willing to undertake the surgical treatment, and their immediate results were usually so favorable that it seemed as though the surgical treatment had become permanently established. Recent literature, however, indicates that surgeons with a considerable experience report approximately fifty per cent. of recoveries extending over at least two years. Those who report fewer cases show a larger percentage of recoveries, but it is scarcely fair to count these cases, because it is likely that in this group a greater proportion of favorable than unfavorable instances are reported, *i. e.*, of all surgeons who have operated upon only one or two of these cases those who have been fortunate in their results will feel inclined to encourage others, while those who have been unfortunate abandon the subject as unworthy of special attention.

Drainage, irrigation and medication of the abdominal cavity are not only considered useless by many writers of great experience, but actually undesirable, and the simpler the operation performed the better will be the result according to these authorities. This idea is illustrated in many of the instances that were found to suffer from tubercular peritonitis when the operation had been performed with the expectation of removing an ovarian cyst, the fluid drained and the abdominal wound either drained or closed. In many such cases the condition appeared absolutely hopeless and it seemed to be foolish to do anything at all.

A very large number of similar cases have been reported by different authors and the literature contains many interesting compilations of cases which appear to show great benefit from abdominal section. During the past few years it has been shown that the results in cases treated for tubercular peritonitis in the medical departments of many of the great hospitals were

about the same as those in the surgical clinics. If these observations are correct it would appear as though these patients should be placed under medical rather than surgical treatment, because the latter is, of course, connected with a greater amount of pain and a slight amount of danger from the operation itself. That many cases have recovered permanently and completely after abdominal section there can be no doubt, because this has been positively proven by autopsies upon patients who died from other causes, when they were found completely cured, tuberculosis having been demonstrated at the operation and the diagnosis confirmed microscopically.

Many of these patients have later been operated for other conditions and the peritoneum has been found so entirely free from evidences of tuberculosis that it seemed impossible to imagine it to be the same peritoneum. We have made this observation in a number of our own patients.

Although the diagnosis cannot be made so positively in those treated without operation, it seems clear that many undoubted cases have been cured by medical and hygienic measures. Since the introduction of the tuberculin and Von Pirquet's tests a positive diagnosis can be made even in cases not operated, hence statistics in the future will, of course, be more acceptable.

An analysis of the various papers on both sides of this controversy shows, it seems, that the authors were not discussing the same class of patients.

Medical Treatment Generally Instituted Early.

The medical practitioners seem to deal with these cases earlier in the attack, while the condition is still more or less acute; on the other hand, surgeons meet with the cases in the chronic condition after those which are curable by medical treatment have been eliminated. In other words, the medical treatment is virtually applied to all cases at first, and if persisted in will result in approximately fifty per cent. of cures, of which about one-half have a recurrence after a number of years. If the medical treatment in the remaining fifty per cent. of cases is continued after the time when it becomes apparent that it has no beneficial effect, then the chances are that such cases will go from bad to worse until they succumb. If, however, surgical treatment is employed in these cases in which medical treatment has proven to be of no benefit, then all of the cases of this group which recover permanently, as well as those which are temporarily improved, constitute an absolute gain, because they reduce the failures from the internal treatment and increase the favorable results by their entire number.

It is interesting to note that all authors who favor the medical treatment of these cases insist upon beginning during the early part of the attack, in fact, as soon as the diagnosis has been made. They all advise primarily hygienic measures; rest in bed, intestinal antiseptics, some form of creosote, and some form of iodine to be given internally; also sterilized, concentrated food and living and sleeping in the open air.

Many external applications have been advised, especially ointments containing some form of iodine or mercury. Those advising surgical treatment combine hygienic treatment with it and advise that this be continued indefinitely after the recovery from the operation.

Of those who advise operative treatment several surgeons of large experience caution against operation too early in the attack, because recurrence is more likely in case the operation is performed before the tubercles

are fully developed. It has been demonstrated experimentally that this is a wise precaution to take, because new tubercles developed in animals after an early laparotomy, while in other similar animals a later operation has resulted in a permanent cure. The cure is attributed to the secretion of an antitoxin which, it is claimed, is not produced before the tubercles have been fully developed.

Many experiments have been made to determine the manner in which the cure is accomplished. It has been demonstrated in animals, upon which an artificial tubercular peritonitis had been produced, that the abdominal section is followed by a severe hyperemia which lasts longer than in cases not suffering from tubercular peritonitis. This is considered the curative element which is attributed to the action of the air upon the diseased peritoneum, as it does not occur when the animals are kept submerged in normal salt solution during the operation. Other authors have attributed the curative effect of abdominal section to an antitoxin produced from the dead bacilli, which will be absorbed. These conclusions are also based upon experimental research. It has been found that the antitoxic effect of the ascitic fluid increases with its age.

Resume of Cases.

We have had occasion to review personal experience in the treatment of tubercular peritonitis by laparotomy. The accompanying table contains all the cases of tubercular peritonitis upon which abdominal section has been done at the Augustana Hospital during the past few years, with the hope of obtaining a permanent cure. This group (see following table) contains thirty-two cases, varying in age from nine to fifty-six years. Since constructing this table a few years ago, we have treated a considerable number of patients suffering from tubercular peritonitis whose outcome serves to still further confirm the views we have expressed upon this subject. (We now have operated upon more than three times this number of cases, but it does not seem proper to take up the space necessary to tabulate all of these because they show that our views expressed a few years ago must be considered correct, although the additional vaccine treatment has still further improved both the surgical and the non-surgical result. The use of out-of-door sleeping apartments has also been of great benefit in the treatment of these cases).

From the age of 8 to 19 there were 11 cases.

From the age of 19 to 29 there were 9 cases.

From the age of 29 to 39 there were 6 cases.

From the age of 39 to 49 there were 3 cases.

Above the age of 49 there were 3 cases (55, 56, 58 years of age).

There were twenty-four female and eight male patients.

But one patient died as a direct result of the operation, on the seventh day, from exhaustion. The appendix in this case was tuberculous and was deeply imbedded between the cecum, the ileum and the omentum. Its removal necessitated a very tedious dissection. It seemed at that time that it would not be good surgery to leave this infected organ in the abdominal cavity. The patient was fifty-five years of age and her resistance was not good. She never reacted from the operation. We are now positive that this was bad surgery, because in other similar cases in which we simply removed the fluid, exposed the peritoneum to the air and closed the abdominal

wall, draining the cavity for a week or longer, the patients have usually done surprisingly well.

In this series (see table) there were several such (Nos. 2, 8, 10, 15, 16, 18, 19, 23, 27, 30, 31, 32) in a similar and, in fact, most of them in a worse condition. Several were so advanced that nothing was done after the abdomen was opened except to empty the fluid, because it seemed absolutely useless, the cases being apparently in a hopeless condition. Nevertheless they recovered from the operation and many have been perfectly well for many years, as will be seen from the table.

We were impressed most thoroughly with this fact by two cases, whose histories will be given in abstract to illustrate the extent to which recovery may occur in instances in which the pathological condition at the time of the operation seemed to preclude the possibility of a complete recovery. The first of these does not belong to the group in the accompanying table, because she was not operated in our hospital. We simply quote the case because it shows more perfectly the possibilities in these conditions than any of the cases in the present group.

In June, 1891, we operated upon a married woman, twenty-six years of age, whose ovaries, tubes and uterus were imbedded in a thick mass of tuberculous tissue so extensive that it seemed absolutely useless to attempt their removal. The cecum, omentum and the small intestines were also matted together, a condition very similar to that found in Case 31. The entire parietal and intestinal peritoneum was thickly studded with tubercles. The remaining abdominal space was greatly distended with fluid and we simply inserted a drainage tube in the hope of giving the patient a slight amount of temporary relief and closed the remaining portion of the abdominal wound. She recovered slowly but was able to return to her home in six weeks. It is now nineteen years since we performed this operation, and the patient is a strong, healthy woman and has given birth to two healthy children. When we inquired six years after the operation of her family physician for the date of death after her return to her home from the hospital, we were amazed to learn of the subsequent history, in part as stated above.

Case No. 8 of the group is a similar example. This patient came under our care May 1, 1896, and was operated on the following day. She was then fifteen years of age, was reduced to a skeleton, weighing but sixty-two pounds. The abdomen was distended to the size of a five months' pregnancy, she was compelled to sit with her knees drawn up on her abdomen so that she rested her hands and her forearms upon them and on these she rested her chin. This was the only position in which she could be comfortable. We performed an abdominal section; finding four pints of free fluid. The intestines, omentum, ovaries and tubes were so thoroughly imbedded in masses of tuberculous tissue that the case seemed hopeless. A drainage tube was inserted. The patient began to gain slowly but steadily. She took anti-tuberculous remedies for several years and developed into a beautiful, healthy woman. In a letter we received a few days ago, she states that her health is perfect, that she now weighs one hundred and twenty pounds—which is more than double her weight at the time of the operation after the ascitic fluid had been removed. Her photograph, which she sent, shows her to be vigorous, well-nourished, beautiful, and evidently completely recovered from her tuberculous disease.

Of the patients who died a short time after the operation, but not di-

Hospital Number	Name	Age	Sex	Admission	Discharge	Diagnosis	Treatment	Result.
723	H M	17	F	May 32, '91	June 7, '91	Acetic form, peritoneum greatly thickened. Small tubercles over entire peritoneum, intestines, omentum, tubes and uterus.	Laparotomy. Tubular drainage ten days nothing removed. Eight quarts of fluid.	Recovered. May 13, 1902, eleven years since the operation has been perfectly well with exception of a few weeks illness.
770	L S	58	F	Aug 22, '91	Sept 12, '91	Tuberculous peritonitis. Peritoneum covered with small tubercles. Ovaries and tubes adherent in pelvis in tubercular mass.	Considerable quantity of fluid removed, not measured.	Recovered.
803	I C	18	F	Apr 9, '92	Apr 23, '92	Tuberculous peritonitis. Ascitic form entire peritoneum covered with tubercles. Parietal peritoneum greatly thickened.	Laparotomy and drainage. Drainage remained one week. Removed twenty-five pints of fluid.	Recovered.
976	H S	32	F	Oct 10, '92	Nov 30, '92	Tuberculous peritonitis. Diffuse with ascites and gaseous masses and enlarged mesenteric lymph glands.	Laparotomy. Removed large tubercular mass surrounding both ovaries and tubes.	Recovered.
978	L B	39	F	Oct 11, '92	Dec 8, '92	Tuberculous peritonitis.	Laparotomy. Drainage. Drained for one week. Removed tubercular ovaries.	Recovered.
2362	A A	16	F	Sept 8, '95	Oct 27, '95	Tuberculous peritonitis. Both ovaries and tubes completely covered with tubercles.	Laparotomy draining cavity. Abdominal wound closed. Both ovaries removed.	Recovered. May 17, 1902, in six and one-half years after operation. Is well and has been ever since leaving hospital, but has small fistula.
2426	E L	23	F	Oct 6, '95	Nov 22, '95	Tuberculous peritonitis diffuse with ascites, complicated with tubercular ovarian cyst as large as a fist.	Laparotomy. Excision of cyst. Drainage continued for two weeks.	Recovered.
3844	N H	15	F	May 1, '96	June 12, '96	Tuberculous peritonitis. Intestines, omentum, all pelvic organs in one continuous mass of adhesions, thickly covered with tubercles. Parietal peritoneum greatly thickened and one mass of tubercles. A slight amount, about two quarts of fluid.	Laparotomy. Drainage continued for two weeks.	Recovered. May 14, 1902. Six years after operation is in perfect health, weighs 120 lbs. a gain of 58 lbs. Was almost a skeleton at time of operation and was perfectly helpless.
3263	J A	37	M	Oct 4, '96	Oct 26, '96	Tuberculous peritonitis.	Laparotomy. Drainage.	Recovered. Died two and one-half years after operation from recurrence.
3796	C A	10	M	May 16, '97	June 26, '97	Tuberculosis of entire peritoneum. Appendix and mesenteric glands tuberculous. A small amount of ascitic fluid.	Laparotomy. Excision appendix and tubercular mesenteric glands.	Recovered.
3898	E. H.	33	F	June 16, '97	Aug 13, '97	Tuberculous appendicitis and diffuse peritonitis with ascites.	Laparotomy. Excision of appendix. Drainage for one week.	Recovered. May 16, 1902. Five years since operation. Is in excellent health but lives in Alabama in better climate.
3345	F. S.	25	F	Aug. 14, '98	Aug. 30, '98	Tuberculous peritonitis and appendicitis with slight amount of ascites.	Laparotomy. Excised appendix and drained for one week.	Died as a result of operation from exhaustion on seventh day.

6474	13	S. P.	21	M.	July 30, '99	Sept. 15, '99	Tuberculous peritonitis. Large amount of ascites.	Laparotomy and drainage for two weeks.	Recovered. May 17, 1902, nearly three years after operation, patient examined and found perfectly well.
6777	14	J. A.	22	F.	Oct. 9, '99	Nov. 5, '99	Tuberculous peritonitis complicated with tertiary syphilis.	Laparotomy and drainage for two weeks.	Died four weeks after operation from exhaustion, the disease progressing.
6963	15	J. R.	9	M.	Dec. 3, '99	Jan. 7, '00	Traumatic tuberculosis. Attack very violent, following a fall upon abdomen upon the edge of a curb stone during apparently good health. The entire peritoneum was thickly covered with tubercles, the abdominal cavity contained ten pints of fluid.	Laparotomy and drainage for ten days.	Recovered. Patient is perfectly well and strong, May 15, 1902, two and one-half years after operation.
7105	16	L. G.	22	F.	Jan. 14, '00	Feb. 11, '00	Diffuse tuberculous peritonitis. Contained fifteen pints of fluid. Ovaries, tubes and sigmoid in a mass of tubercular tissue.	Laparotomy and drainage for one week.	May 15, 1902, two years after operation, perfectly well since returning from hospital.
7269	17	W. M.	27	F. M.	Feb. 22, '00	Mar. 31, '00	Tuberculous peritonitis. Ascitic form.	Laparotomy, drainage for one week.	Recovered.
7399	18	J. H.	27	F.	Mar. 21, '00	June 11, '00	Tuberculous peritonitis. Intestines and omentum in a mass of tuberculous tissue. Mesenteric glands tubercular, pelvic organs adherent in a mass of tubercular tissue, very slight amount of fluid.	Laparotomy and drainage for one week.	Recovered. May 14, 1902. Is well and able to do all the house-work.
7491	19	E. D.	26	F.	Apr. 16, '00	June 7, '00	Tuberculous peritonitis. Fallopian tubes and ovaries imbedded in a mass of tuberculous tissue in pelvis. Peritoneum universally thickened and covered with tubercles.	Laparotomy and drainage two weeks. Moderate amount of fluid.	Recovered.
7569	20	O. B.	19	M.	Apr. 30, '00	June 9, '00	Tuberculous peritonitis. Mesenteric glands generally involved. Very slight amount of fluid.	Laparotomy. Sponged out cavity with hot sponges wrung out of normal salt solution. No drainage.	Recovered.
8000	21	G. S.	10	F.	Aug. 21, '00	Sept. 21, '00	Tuberculous peritonitis. Diffuse miliary form with great amount of ascitic fluid, not measured.	Laparotomy. Removed fluid. Wound closed.	Recovered. Died from diffuse miliary tuberculosis Dec. 20, 1900, four months after operation.
8130	22	C. H.	43	M. M.	Sept. 18, '00	Oct. 16, '00	Diffuse tuberculosis of peritoneum. Pancreas tuberculous.	Laparotomy. Removed fifteen pints of ascitic fluid. No drainage.	Died four weeks after operation, the disease progressing constantly.
8188	23	E. M. F.	30	F.	Sept. 21, '00	Oct. 31, '00	Diffuse tuberculous peritonitis, ascitic form. Ovaries and tubes in a mass of tuberculous tissue in pelvis.	Laparotomy. Removed large quantity fluid. Closed abdominal wound.	Recovered.
824	24	A. W.	15	F. S.	Dec. 6, '00	Jan. 11, '01	Diffuse tuberculosis of peritoneum, with adhesions. Appendix free, but double normal size in a mass of tubercles.	Laparotomy, evacuated small amount of fluid also tuberculous appendix. No drainage. Intestines and omentum adherent, also ovaries, tubes and uterus. Adhesions not disturbed.	Recovered. Had severe attack of pleurisy with effusion four months later, from which she recovered. May 20, 1902. The patient is in excellent health, living in California.

852028	H. W. 22	P. Dec 27, '00	Jan. 31, '00	Tuberculous peritonitis and tuberculous appendicitis. No ascites. Peritoneum studded with tubercles, but not completely covered, not much thickened.	Laparotomy. Excision of appendix.	Recovered May 16, 1902. Patient well one and one-half years after operation.
856020	C. J. B. 34	F. Jan 6, '01	Feb 01, '01	Tuberculosis of peritoneum and appendix and fallopian tubes. No ascites. Peritoneum studded with tubercles in all parts but not much thickened except over fallopian tubes.	Laparotomy. Excision of appendix, both ovaries and tubes.	May 12, 1903, sixteen months since operation. Patient is well and has gained greatly in strength and somewhat in weight.
896327	A. S. 16	M. Apr 1, '01	Apr 17, '01	Tuberculous peritonitis, fibro adhesive variety with intestinal obstruction. Appendix imbedded in thick mass of tuberculous tissue. Entire peritoneum greatly thickened.	Laparotomy. Nothing removed. Wound closed.	Recovered May 16, 1902. Patient is fat and well, about one year after operation.
939029	E. T. 56	M. July 10, '01	Aug 5, '01	Tuberculous peritonitis. Abdomen distended with ascitic fluid.	Laparotomy. Drainage for one week.	Died five weeks after operation, disease progressing constantly, the pulmonary tuberculosis increasing enormously after the operation.
978029	F. J. 47	S. Oct 4, '01	Nov 17, '01	Tuberculous peritonitis. Intestines and omentum adherent. Ascites twenty pints of fluid removed.	Laparotomy. Drainage for two weeks.	Not improved.
1000230	Mrs. F. 40	F. Nov 23, '01	Jan 15, '02	Tuberculous peritonitis. Peritoneum two mm thick. Intestines and omentum and parietal peritoneum diffusely adherent. Two pints of fluid isolated in pelvis.	Exploratory laparotomy. Found it impossible to reach fluid without danger of causing intestinal fistula, hence abdominal wound was closed and pelvis drained through vagina.	Recovered May 16, 1902, patient very well, able to do hard work five months after operation.
1022431	Mrs. H. 38	F. Jan 22, '02	Feb 20, '02	Tuberculous peritonitis. Ovaries and fallopian tubes surrounded by a mass of tuberculous tissue. Cecum, small intestines and omentum also adherent in similar mass.	Laparotomy. Drainage for ten days. Five pints of fluid from space between tuberculous mass in pelvis and in upper portion of abdominal cavity.	Recovered May 16, 1902. Patient is still weak, four months after operation.
1040432	C. D. 19	P. Mar 18, '02	Apr 15, '02	Diffuse tuberculous peritonitis. Appendix, cecum, ovaries and fallopian tubes covered with thick masses of tuberculous tissue.	Laparotomy. Drainage.	Recovered May 15, 1903. Patient well, two months after operation.

rectly as a result thereof, it seems important to observe that in Case 14 the condition was complicated by tertiary syphilis, the abdominal ascites, due to the tubercular peritonitis, increased constantly and the patient's condition became more serious under the anti-syphilitic treatment which had been instituted previous to the operation. It seemed as though the patient could be more readily relieved of the syphilis after being relieved of the ascites, but the result was quite the reverse. It is possible that the operation hastened her death, although she was rapidly approaching a fatal conclusion when the operation was performed.

In a similar case since the above we have treated the syphilis by placing the patient's body in a tent placed over her bed with the head projecting through an opening which fitted tightly about the neck after the manner of a hot-air cabinet, then we filled this tent with hot air generated by a Bunsen gas burner. After the patient had begun to perspire freely an iron dish containing one hundred and twenty grains of calomel was placed over the flame, causing the calomel to evaporate, and fall upon the patient's moist skin. This treatment was repeated once daily for one month when the evidences of the syphilis had disappeared. Of course the necessary precautions were observed to prevent salivation. The teeth were carefully cleansed and absolutely nothing containing acids was given by mouth. A saline laxative was administered every morning and the nutrition and general hygiene of the patient were carefully controlled. After removing the syphilis in this manner, which did not interfere with her nutrition but rapidly increased her strength and improved her general health, she made a normal recovery from her tuberculous peritonitis.

This method is mentioned because in many cases in which syphilis does not yield to the administration of mercury by mouth or by inunctions or by intramuscular injection, in weak patients the disease yields at once upon instituting this form of medication.

Case 21 improved rapidly after the operation and was able to return to her home after one month, but succumbed to a new invasion three months later. It is not likely that the diffuse, miliary tuberculosis of which she died had any relation to her operation.

Case 22 was complicated with the comparatively rare condition of tuberculosis of the pancreas. The patient was more comfortable after the operation, but it is not likely that the procedure either lengthened or shortened her life.

In Case 27 a latent pulmonary tuberculosis became very active directly after the operation. It is probable that he would have lived a little longer without the operation. It has been observed that patients with a tubercular family history, suffering from even a slight pulmonary tuberculosis complicating the tubercular peritonitis, do not recover readily from the latter condition after abdominal section. In this class of patients living and sleeping out of doors and careful feeding and non-irritating intestinal anti-septics undoubtedly should be employed most carefully before an operation is undertaken.

In twenty-one out of thirty-two of the patients in this series we have obtained definite information concerning their history after leaving the hospital. Of these cases fifteen were well from one to eleven years after the operation, five had died, two are too recent to be considered except from the standpoint of immediate recovery from the operation. Ten cases we have

not been able to trace; they belong to the laboring classes who have no permanent homes.

All of these patients had been under internal treatment for a considerable period of time before the abdominal section was performed, without being benefited; several of those who have apparently made a permanent recovery were in what seemed to be an entirely hopeless condition when they entered the hospital.

A study of the literature, together with a review of our clinical experience with the cases contained in the accompanying table, and with those that have been under observation since this table was compiled, seems to warrant the following conclusions:

Conclusions.

1st. Patients suffering from tubercular peritonitis should first be subjected to careful medical, dietetic and hygienic treatment.

2nd. This treatment should consist in the use of intestinal antiseptics, anti-tubercular remedies and rest in bed. Sterilized food and improved hygienic conditions generally should be employed. The vaccine treatment should be carefully tried in these cases.

3rd. So long as the patient's condition improves reasonably this treatment should be continued.

4th. In case the patient's condition does not improve, or becomes worse, abdominal section is indicated.

5th. If the disease is confined to a part which can be safely removed without injuring any portion of the tuberculous peritoneum this should be done, provided the surface can be covered with healthy peritoneum.

6th. If the removal of any infected portion necessitates the severing of the tuberculous peritoneum or leaving a portion of the peritoneal surface denuded, the diseased tissue must not be disturbed.

7th. In case there is fluid in the peritoneal cavity it is doubtful whether it is best to remove any tuberculous tissue, even though it be circumscribed.

8th. Enormous quantities of the tuberculous material can be absorbed from the peritoneal cavity after simple laparotomy.

9th. It is best to avoid all manipulation of the intra-abdominal organs during the operation, in case there is a diffuse tuberculous infection, and to confine the operation to simply opening the peritoneal cavity, permitting the fluid to drain out, admitting air to the peritoneal cavity, draining the cavity with a glass tube covered with gauze and closing the abdominal wound.

10th. Peritoneal adhesions should never be disturbed in patients suffering from tubercular peritonitis with ascites for fear of causing intestinal fistulæ.

11th. During the time of recovery from the surgical operation, and for a considerable period of time after this, the patient should be treated medically.

12th. The hygienic conditions of the patient must be permanently improved and he must not be permitted to expose himself to the influences which primarily caused the tuberculous infection.

13th. Permanency of cure is much more likely in patients who are not predisposed to pulmonary tuberculosis.

14th. Chronic cases with fluid, particularly if encapsulated, and not benefited by medical and hygienic measures, are especially amenable to surgical treatment.

15th. Repeated operations are indicated in case of re-accumulation of fluid.

16th. It is important to regulate the hygiene and diet of these patients permanently after they have recovered from this disease.

17th. It is especially important to locate the source of the primary infection and to make reinfection from this source impossible.

18th. If possible they should change their residence sufficiently to insure satisfactory hygienic conditions.

19th. All milk and all meats should be sufficiently cooked to prevent reinfection from these sources.

20. In employing the vaccine treatment it is of the greatest importance to use a very small dosage, a good rule being to administer one-half of the smallest dose that will cause the slightest reaction.

GENERAL CONSIDERATIONS IN BOWEL SURGERY.

The greatest number of operations upon the intestines are performed for the relief of mechanical obstruction. This may be due to strangulation, as in strangulated hernia, or constriction due to a cicatricial band or an adherent Meckel's diverticulum, or an adherent appendix or a volvulus. Again operation may be needful for the relief of obstruction due to a foreign body in the alimentary canal, such as a gall stone or an enterolith, or to a malignant growth occluding the lumen of the intestine or to an intussusception.

General Principles in Bowel Surgery.

There are a few general principles which should be borne in mind in all surgical work upon the intestine, viz.

1. The circulation should be as perfect as possible at the point of operation. There is always great danger of interfering with the blood supply when sutures or ligatures are applied in the vicinity of the omentum or the mesentery.

2. Care should be taken never to apply stitches or ligatures to the omentum near its attachment to the colon, because this is frequently followed by gangrene.

3. In all operations it is important to apply the sutures so that the two layers of the mesentery are held together, because the space between these layers is not covered with peritoneum and is consequently deprived of nutrition if this precaution be not taken. When an end-to-end anastomosis is made in the small intestine this danger can be still further guarded against by placing the ends so that the mesentery does not come directly in apposition in the two segments, twisting one segment a few degrees to the right and the other a few degrees to the left, so that there is a distance of about one-eighth of the circumference of the intestine between the mesenteric attachments of the two segments.

4. The same principle applies to the choice of location and form of the anastomosis. It is always safer to make an anastomosis where it is possible to unite surfaces which are covered with peritoneum, hence in many instances a side-to-side, or an end-to-side anastomosis is to be preferred to an end-to-end junction.

5. Tension should always be avoided.

6. The omentum can be utilized to enforce an anastomosis by supplying nutrition from its rich circulation.

7. When an anastomosis or enterorrhaphy is performed after removing a portion of gangrenous intestine the proximal segment is likely to cause leakage unless the enterorrhaphy is made a considerable distance above the portion of intestine that was gangrenous.

8. In case of tumors of the mesentery it is wise to make an anastomosis which will permit the passage of intestinal contents above the point at which the nutrition has been impaired by the removal of a mesenteric tumor.

9. Care must be taken to prevent angulation, which will result later in obstruction.

10. Allowance must be made for shrinkage of the anastomosis openings, due to cicatricial constriction.

11. Care must be used to prevent free spaces underneath intestines through which herniæ may occur later.

12. Raw surfaces should never be left in intestinal operations because adhesions are especially bad in these cases.

EXCISION OF THE CECUM.

Typical History.

The patient is a farmer fifty-six years of age who gives the following history: Family and previous history negative. Has enjoyed good health and has been able to work hard until a few months ago. The only discomfort he has experienced has been from chronic constipation which has existed for many years, but which has alternated during the past year with acute attacks of "dysentery" which have lasted but a day or two at a time. He has suffered from indigestion and from gaseous distension of the abdomen. The latter condition has become worse constantly during the past few months. In the meantime the patient has lost forty pounds in weight, his appetite having constantly become more and more impaired, and during the past few weeks he has frequently experienced a feeling of nausea.

He is a somewhat emaciated, slightly cachectic man, skin dry, very slightly jaundiced, tongue coated, appetite poor, severely constipated, heart, lungs and kidneys normal, temperature slightly sub-normal. Abdomen thin-walled, soft, slightly distended, peristalsis of small intestines can be seen on surface of the abdomen. At a point half-way between the end of the twelfth rib and the anterior superior spine of the ilium a hard, oval, slightly lobulated mass apparently four inches in length and two inches in diameter can be felt through the abdominal wall. It is slightly movable and not especially painful upon manipulation. It seems to be attached posteriorly. Upon inflation of the colon by means of a bicycle pump attached to a rectal tube the tumor is not displaced and the gas does not distend the colon in front of it. The distension seems to extend to a point directly above the beginning of the tumor.

Diagnosis.

A careful review of this history must direct our attention to the existence of partial obstruction of the alimentary canal, which is increasing in character and has of late become almost complete, as indicated by the frequent feeling of nausea.

The location of the tumor corresponds to the cecum or the ascending colon. Its sessile nature would indicate the same organ. The fact that it is

not disturbed by the inflation of the colon would eliminate the kidney and the gall bladder. The fact that continued treatment with cathartics does not affect the size or form of this tumor, would eliminate fecal impaction. The age of the patient and the cachexia would point toward malignancy. We will consequently make a diagnosis of carcinoma of the cecum or the ascending colon, or both.

Indications for Treatment.

There has been a constant increase in the obstruction, hence it is to be expected that a complete interference must occur soon. In order to avoid this some radical measure must be instituted. Moreover, this should be undertaken before the patient's strength has declined still more. We shall consequently advise an operation as soon as the patient has received the necessary preparation.

Complete intestinal obstruction might occur in this case at any time by the occlusion of the slight remaining opening in this intestine with some small mass of undigested food. A small piece of meat fiber or an orange seed, and in a number of cases an enterolith, has been observed to cause a complete obstruction. In case this occurs the condition becomes exceedingly grave at once, because the same symptoms will arise which characterize acute mechanical obstruction of the intestine, namely, pain, sudden gaseous distension of the abdomen, nausea, vomiting and shock. Patients quite advanced in age and greatly reduced by long-continued disease do not bear this condition well.

The Question of an Immediate Operation.

The question consequently arises as to the advisability of an immediate operation when a complete obstruction has occurred. Should the patient come under treatment at once the immediate operation is undoubtedly indicated, because the intestines are still in a good condition and the patient has not lost much strength. It has, however, been our experience that these patients have become accustomed to the use of strong cathartics and that consequently they are likely to employ such means for several days before consulting a physician, changing from one to the other drug until they are completely exhausted. In such examples we have found that an immediate operation is usually followed by the speedy death of the patient, because his strength has been greatly impaired and great pressure has been brought to bear upon the badly nourished intestinal walls above the point of obstruction from the constant use of strong cathartics. The intestines are distended, making an operation extremely tedious. This distension is accompanied by a greater permeability of the walls to the passage of micro-organisms, hence an infection is favored in this manner. It usually becomes necessary to open the intestine and to permit its contents to escape before the bowels can be replaced in the abdominal cavity. This evacuation should be accomplished through a large glass tube, to be described presently, through which the intestine should be thoroughly irrigated with normal salt solution at 105° to 110° F. The administration of cathartics after complete obstruction has occurred accounts for the extremely high death rate in cases operated upon under these conditions.

For a number of years we have consequently followed another plan and have found it far safer for the patient. Many cases brought to the hospital in an apparently hopeless state have improved from day to day and were

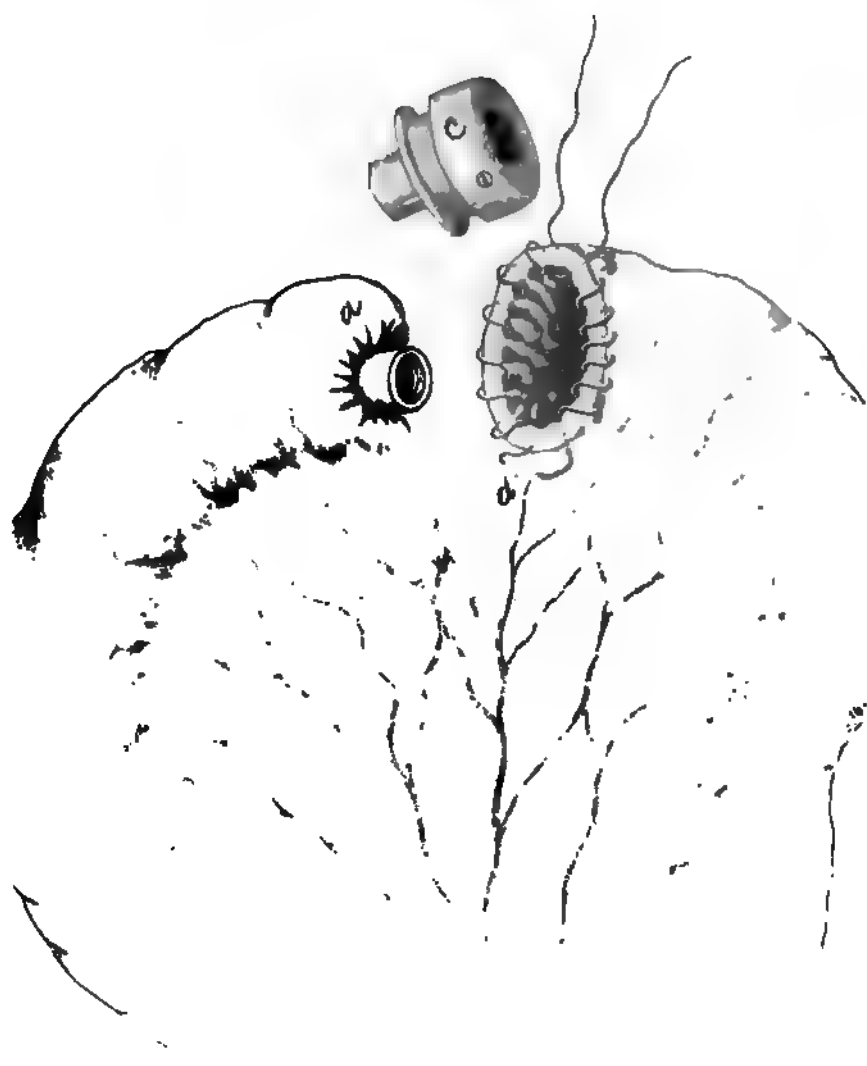


PLATE XXXII.

INTESTINAL ANASTOMOSIS.

End to end with Murphy button. (a) button in place with purse-string suture tied. (b) end of intestine with suture in place, showing manner of including mesentery at (d). (c) a mesenteric vessel is represented as tied at a point a little below and to the left of (d). (e) represents the remaining half of the button to be introduced into the segment (d).

presently carried to a point at which it was possible to perform the necessary operation safely. Of course there are cases which are moribund at the time of admission to the hospital and these will die, usually within a few hours after admission, no matter whether or not they are operated.

Conservative Treatment.

The treatment that has been followed by the greatest percentage of recoveries in our experience has consisted in reducing the pressure, as much as possible, above the point of constriction. This can be accomplished best by performing gastric lavage several times, at intervals of a few hours, under cocain anesthesia of the pharynx. There is usually a regurgitation of decomposing material into the stomach, which will be removed by the gastric lavage. In this manner the stomach, and the intestine above the obstruction, soon become emptied of decomposing material and gas. The distension disappears gradually, the intestinal walls seem to regain their power of contraction, the absorption of products of decomposition ceases and the patient's condition improves practically in all cases in which the intestines still contain a sufficient amount of tone to force their contents back into the stomach by return peristalsis.

The emptying of the intestines above the point of obstruction can be further facilitated by elevating the foot of the bed, which favors the flow of intestinal contents back into the stomach where the accumulation will be indicated by the presence of nausea, which is again relieved by gastric lavage. This precaution is of importance moreover because it will protect the patient against drowning in his own vomit, an accident which we have observed several times.

In case the obstruction is due to the wedging of a fine substance into a constriction caused by the presence of a carcinoma in the colon the method named of relieving the pressure from above may result in its dislodgment.

Maury has shown that patients with intestinal obstruction are severely poisoned by a secretion from the mucous lining of the duodenum, which explains why many of them recover so splendidly after repeated gastric lavages, because this poisonous substance is regurgitated into the stomach and washed away by the lavage.

In the meantime the patient is supported by the use of nutrient enemata, one ounce of liquid predigested food being dissolved in three ounces of normal salt solution and administered through a soft catheter inserted into the rectum a distance of about two inches. This should be repeated once in four hours. If the patient suffers from thirst half a pint of normal salt solution may be given as an enema in the same manner every hour until the thirst has subsided. It is important not to introduce the catheter a greater distance than about two inches because otherwise one frequently observes severe irritation.

This treatment can usually be continued with benefit and with safety for a number of weeks. In many cases the absence of irritation and pressure from above will result in the passage of gas and liquid feces through the stricture, because there is always a certain amount of edema which subsides when the irritation has disappeared.

It is best not to give any food by mouth in these patients, after the obstruction has once been complete, until the hindrance has been removed. Should it seem necessary to postpone the operation for a time it is best to continue the use of the nutrient enemata and to give only such nourishment

by mouth as will be completely absorbed from the stomach and small intestines.

After this condition of relief has been attained in cases of complete intestinal obstruction due to the presence of carcinoma in the colon, the treatment will be the same as in those in which the obstruction is not complete. In cases in which the stricture *remains impermeable*, the operation for the relief of the obstruction will have to be carried out at a time which seems favorable in the judgment of the surgeon who has the case under observation. In these cases there can, of course, be no further preparatory treatment.

Preparatory Treatment.

In all operations upon the alimentary canal it is well first to remove so far as possible all of the contents thereof by the administration of cathartics and large enemata and then keeping the patient on sterilized food entirely until the time of the operation. It is well to repeat the cathartics once or twice, if the patient's condition warrants it, in order to remove as much as possible all infectious material from the alimentary canal. Two ounces of castor oil, given in the foam of beer, ale or malt extract, is usually most effective and gives rise to the least amount of irritation.

Especial stress should be laid upon the value of castor oil used in the manner indicated above. From time to time we have tried other cathartics but have become absolutely convinced of the fact that none of them serve the purpose of removing septic material from the alimentary canal so perfectly as this remedy when given in this dose and vehicle. It is tasteless, non-irritating, rarely produces nausea or vomiting and the results are ideal.

In cases in which there is but a small opening left, but which is still permeable we often give two ounces of castor oil once or twice daily for several days before the operation, and follow this by the administration of large normal salt solution flushings of the lower bowel. This clears up the patient's general appearance greatly, as they have usually absorbed fecal material lodged above the seat of obstruction for months before they come under our care. Of course it is of importance in the meantime not to give food which will favor further accumulation.

The patient may chew tender broiled steak and swallow the juice but not the pulp, or take egg albumen, broth, fruit juices and milk with lime water or with milk of magnesia.

The field of operation is prepared in the usual way.

Technique of Operation.

In this patient the tumor can be located definitely, consequently the incision will be made in a position facilitating its removal. It is not possible to determine the exact length of incision that may be required for the removal of this tumor, hence we must choose a location for the incision which will permit of its enlargement. We will choose the outer edge of the right rectus abdominis muscle, as shown in Plate XIV c. This may be lengthened indefinitely if it should seem desirable during the process of the operation.

We find a tumor in the cecum and ascending colon beginning a little above the entrance of the ileum into the cecum. The tumor is about twelve cm. in length and involves the entire circumference of the intestine. It is exceedingly hard, but apparently has not perforated the wall of the bowel at any point. It seems as though the entire growth were still confined to

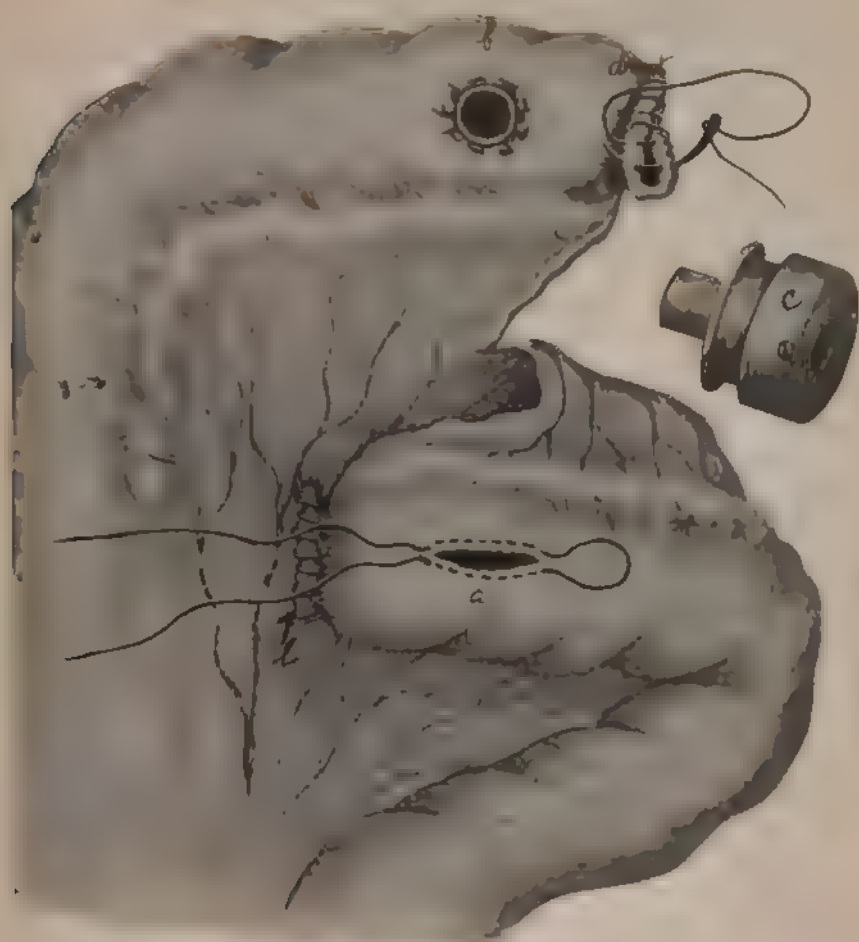
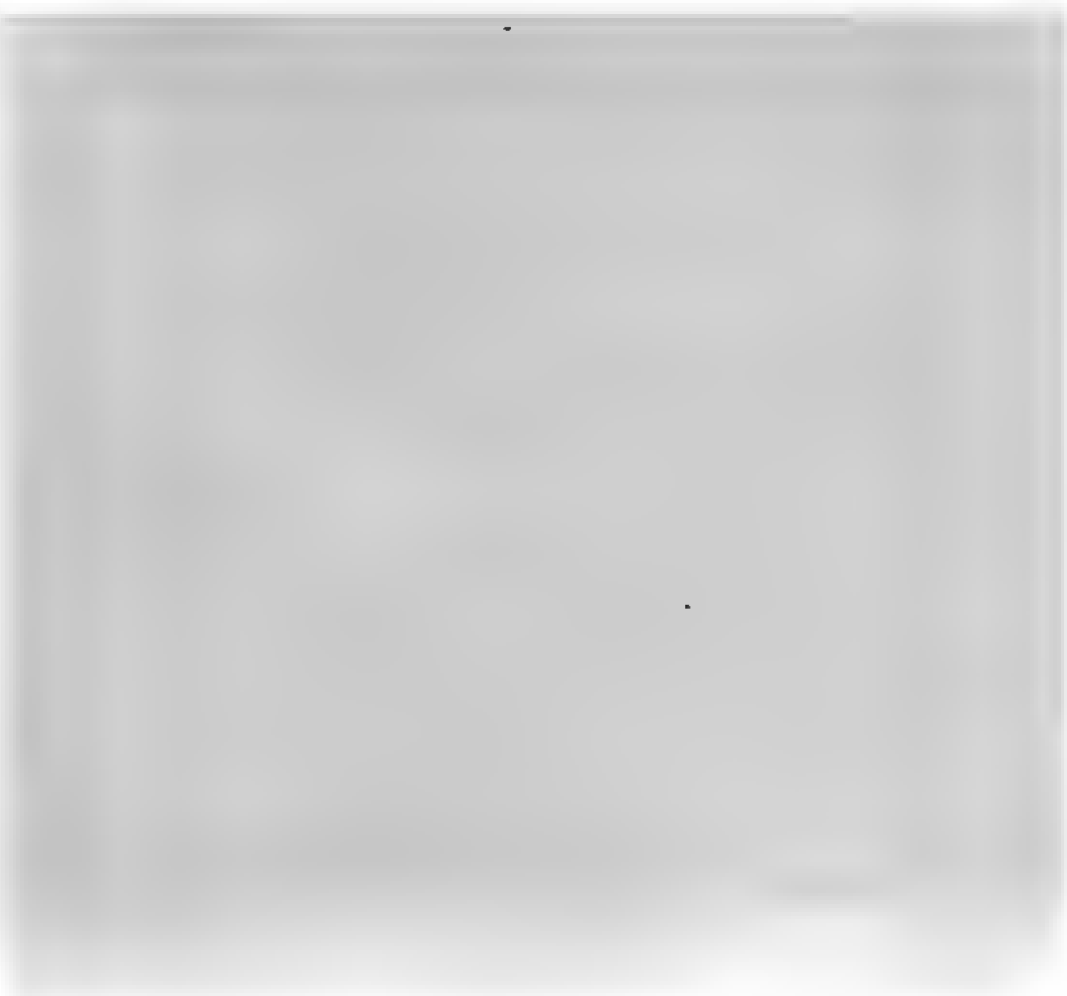


PLATE XXXIII

LATERAL ANASTOMOSIS OF INTESTINES WITH MURPHY BUTTON

This plate does not show the end of the intestine properly; the tissue should be represented as inverted into the lumen of the intestine by means of Lembert sutures at (d) and (e). At (a) the purse-string suture is represented as applied properly with the stitches near the edge of the incision. At (b) the segment of the button is in place and the purse-string suture has been tied. It is better to introduce the button through the open end of the intestine and to make a very small puncture of the wall, just sufficient for the central portion of the button to protrude, then to close the ends of the intestine. It will then not be necessary to apply the purse-string sutures at (a) and (b).

In uniting small intestine with small intestine the end-to-end anastomosis with the Murphy button is to be preferred to the end-to-side or side-to-side anastomosis. In uniting small intestine with colon an end-to-side anastomosis with the Murphy button seems most satisfactory. In uniting colon with colon a lateral anastomosis with needle and thread or with the McGraw ligature seems to give the most satisfactory results.



the intestine and consequently its removal may result in a permanent cure. At any rate it is certainly worth the effort to attempt securing such a result.

It will be necessary to remove the entire ascending colon together with the cecum. We must consequently plan to secure a union between the ileum and the transverse colon. We will first tear an opening through the mesentery of the ileum an inch from its entrance into the cecum. A strong, long-jawed hemostatic clamp is applied to the ileum on the side toward the cecum. A circular, purse-string suture is then applied, either before or after severing the intestine. If the intestine is severed before the suture is applied we prefer to insert the latter after the method illustrated in Plate XXXII, because this insures the holding together of the two layers of the mesentery as well as inclusion in the bite of the Murphy button of a uniform amount of each layer of the intestinal wall.

Before severing the intestine an assistant should grasp it, at a distance of about six inches from the cecum, between his thumb and finger to prevent the leakage of intestinal contents while the button is put in place. The same result may be accomplished by perforating the mesentery between the large vessels which can readily be recognized, and tying a strand of aseptic gauze around the intestine just sufficiently firm to prevent leakage. It is well to draw a snug-fitting pledget of moist aseptic cotton through the button to prevent leakage after it has been tied into the end of the intestine and before it has been united with its fellow. The smaller portion of the button should be employed in this end of the intestine. The button is inserted and the purse-string suture is tied snugly about the projecting central tube of the button and the ends are cut short. Now this end is laid aside and covered with a warm moist pad of aseptic gauze.

The cecum is now lifted out of the abdominal wound by means of the large clamp forceps upon the small portion of ileum which has remained attached to the cecum. The peritoneum together with its blood vessels is now grasped in hemostatic forceps, both to the inner and outer side of the cecum. Then the portion between is cut away with scissors. In this way the cecum and the ascending colon can be freed rapidly.

As the operation approaches the hepatic flexure of the colon it is important to proceed cautiously for fear of clamping the duodenum together with the peritoneum by which the ascending colon is attached. In this manner the hemorrhage can be controlled perfectly and the excision made rapidly. Having reached the hepatic flexure of the colon we are at least eight cm. beyond the tumor. We now apply two pairs of heavy, long-jawed hemostatic clamps transversely across the colon and cut away the tumor by severing the intestine between the two clamps. This will prevent any leakage from either end of the intestine. All of the vessels which have been clamped are now carefully ligated with catgut. At any point at which there seems to be danger of the ligature slipping off it is best to place a catgut suture about the part included in the grasp of the hemostatic forceps.

It is well to bear in mind the fact that the vessels contained in the mesentery have a tendency to retract and that for this reason it is important to exercise great care in their ligation. The suggestion made by W. J. Mayo to split the peritoneum along the inner side of the intestine, expose the vessels, clamp and ligate them is a very good one, especially when the mesentery is not definite in its development, because in this way every possibility of hemorrhage due to slipping of stump or retraction of vessels is avoided.

After perfect hemostasis has been attained a suture is applied to the surface of the transverse colon four inches from its cut end, as shown in Plate XXXIII. Care should be taken to have the ascending and descending thread in this suture not more than one-eighth of an inch apart. The intestine is now held between the finger and thumb of an assistant six inches beyond this point. Its end is enveloped in a pad of moist aseptic gauze. The clamp which had up to the present time closed the cut lumen of the colon is removed. Any bleeding points are caught with hemostatic forceps and ligated. A short cut, Plate XXXIII a, is now made through the wall of the colon, half-way between the two threads of the suture. The Murphy button is carried into the lumen of the intestine and its central projecting tube is carried out through the incision just made. The ligature is tied to hold the button firmly in place, although this is scarcely necessary, because the opening is just large enough for the central projecting tube of the button to protrude. The open end of the colon is now closed by two rows of continuous sutures of fine silk, the first row grasping all of the layers and the

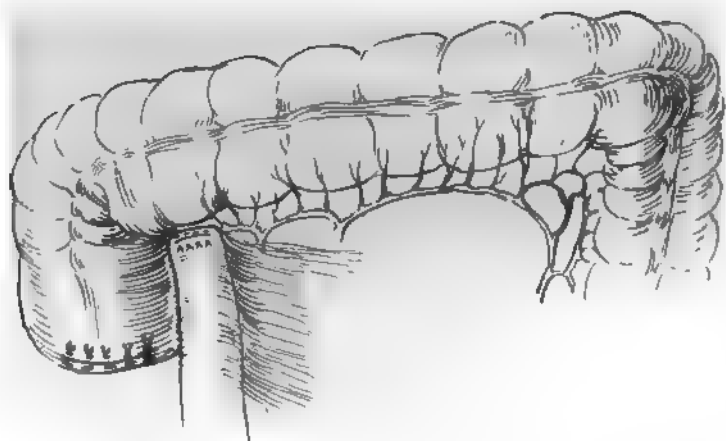


Fig. 14

Lateral anastomosis following excision of cecum and ascending colon, between lower ileum and hepatic flexure. (Mayo.)

second row of Lembert sutures serving to invert the first row into the lumen of the colon. The pledgets of cotton occluding the central tube of the Murphy button are now removed and the two segments of the button are united.

This completes the anastomosis. After carefully sponging off the surfaces and covering the defect in the peritoneum, caused by the removal of the cecum and ascending colon, with surrounding peritoneum, by means of a few catgut stitches, the abdominal wall is closed in the usual way.

In case the obstruction has been complete before the operation so that the patient is so greatly reduced in strength that it seems unwise to expose him to a prolonged operation, it is best to make the anastomosis between the ileum and the colon at the first operation, in order to re-establish a satisfactory communication and then to make the excision of carcinomatous intestine after the patient's strength has been built up.

The Suture Method.

We have given so far the method which we used exclusively until five years ago because it was, in our hands, most satisfactory. Since that time we have, however, discarded all mechanical means for securing union between any parts of the gastro-intestinal canal, not because the wonderfully ingenious Murphy button was unsatisfactory in this especial operation but because we have used the suture method hundreds of times, especially in gastro-enterostomies, and have consequently acquired the habit of doing intestinal work by the suture method rapidly and satisfactorily. For those without much practice in gastric or intestinal surgery we believe that the above method is still the easiest for the surgeon and the safest for the patient, and that in this operation and in end-to-end enterorrhaphy we have the only two operations in which it is proper to use the Murphy button at the present time. In all other operations upon the gastro-intestinal tract the suture method should be used exclusively. The Murphy button must always remain, however, a monument to a brilliant mind and an illustration of the possibilities of surgical ingenuity of the highest order.

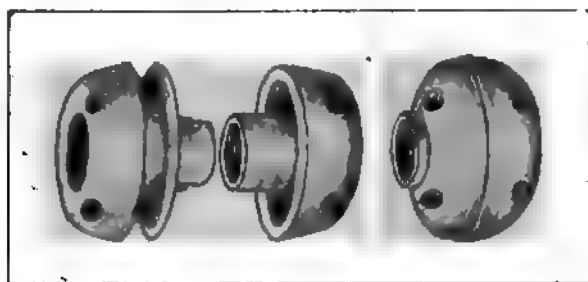


Fig. 15.
Murphy Button.

The Murphy Button.

We have tested the usefulness of this appliance in a large number of these operations, and have found that it is most satisfactory if applied properly. The important points to be borne in mind in the use of the Murphy button are:

1. The button must be well made and must be kept open while not in use, in order to prevent injury to the spring.
2. The silk suture must grasp all of the layers of the stomach or intestine, but it must be applied very near the edge of the incision in order not to draw too much tissue into the bite of the button.
3. The incision through which the button is passed must not be too large, just large enough for the button to pass through.
4. The purse-string suture holding the button must be tied very tightly and the ends cut short, and it is best to arrange the position of the knot so that the knots in the two segments do not meet.
5. If there is any projection of mucous membrane after the purse-string suture has been tied, this should be cut away before the two segments have been united.
6. When the two segments have been united there should be a perfectly smooth union throughout. If there is any projecting tissue it should be

pressed in between the segments of the button by means of a spatula or the flat handle of a scalpel.

7. No sutures should be applied over the button.

8. The button must be placed in healthy tissue, never in the near vicinity of an ulcer or portion of the intestine which is in danger of becoming gangrenous.

Many surgeons object to the use of an appliance which has to remain in the intestine in the form of a foreign body, and these consequently prefer a suture in place of the Murphy button or other appliance. All of these operations can be performed satisfactorily by the use of the suture. In our own work we have usually applied silk sutures in cases in which we did not use the button, but many surgeons prefer catgut.

Rules Governing Sutures.

The same points must be borne in mind in the use of sutures as in the use of the button, namely:

1. The surfaces to be united should be covered with peritoneum.
2. The immediate vicinity of the attachment of the omentum should be avoided.

3. The two layers composing the mesentery should be held together by a carefully applied stitch and the mesentery in the two segments should not be placed in accurate apposition.

4. The first row of sutures should grasp all of the layers of the intestinal wall, but the needle should grasp only a small portion of each layer.

5. The second row of sutures should be applied after the method known as Lembert sutures, which penetrate down to, but not through, the mucous membrane, thus placing in accurate apposition the peritoneal surface throughout the entire extent of the wound. The method has the advantage of affording an opportunity to make the anastomosis as large as one may desire. This is especially advantageous in making an anastomosis between portions of the colon, because in this intestine an extensive anastomosis is desirable. Interrupted or continuous sutures may be applied, but if the latter form is chosen, it is well to take a back stitch every fourth or fifth stitch, in order to insure greater security. Plate XXXIV illustrates the manner in which the sutures are applied in an end-to-end anastomosis, but the same principle will apply in a side-to-side or an end-to-side anastomosis.

After Treatment.

In a general way the after treatment corresponds to that employed in gastro-enterostomy with the difference that food is given by mouth a little earlier and that active cathartics are not given until the button has been passed.

In the suture method cathartics are not given until the end of the second week, and the food is very carefully selected to prevent irritation; predigested foods, buttermilk, broth, gruel, egg-albumen, are most useful.

In using the suture method in place of the Murphy button we simply clamp, ligate and invert the end of each intestine and carefully suture it with Lembert sutures as shown at c Plate XXXIII, then we find a point at which a side-to-side anastomosis between any portion of the ileum and the colon can be made without making tension upon either intestine, then we make an enterostomy at least five cm. in length, using the same method by means of clamps and sutures that has been described in connection with

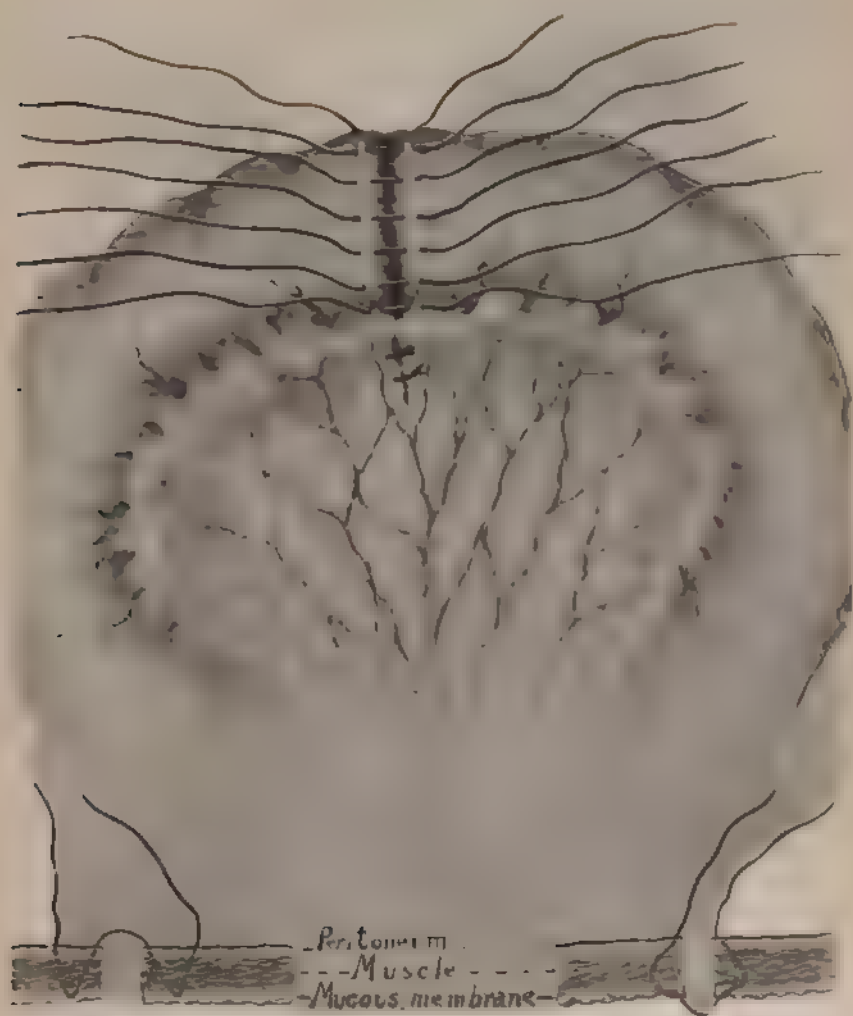


PLATE XXXIV

INTESTINAL ANASTOMOSES. END TO END WITH SUTURES.

Herewith the manner of introducing the sutures is illustrated. To the right the suture grasps all of the layers of the anastomosis; this suture is first applied. To the left the suture passes through all the layers, including the serous connective tissue, but not the mucous membrane; then passing out through all these layers, issuing near the edge of the wound, then passing in and out again on the opposite side of the wound it is ready to be used. It will then unite two serous surfaces. This is the second row of sutures. This is Lambert's suture. Above both rows are in place, but the outer row has been left intact. The latter is represented as interrupted, but continuous sutures may be used and these are preferred by most surgeons.

gastro-enterostomy. The only advantage this operation has over the one with the Murphy button lies in the fact that the opening can be made larger in this operation than in the previous one.

RESECTION OF THE SMALL INTESTINE.

This operation may be indicated by the presence of gangrene of the intestine in strangulated hernia or in volvulus, by severe laceration in gunshot or other wounds, by the presence of tumors or circumscribed tuberculosis or occasionally in cases of intussusception accompanied by gangrene. It may also be indicated by the presence of cicatricial stricture or intestinal fistula. The operation itself is very simple and more depends upon the proper selection of tissue than upon the technique of the operation itself. Whenever the operation is performed in the presence of gangrene care must be taken to go a considerable distance beyond the suspicious tissue. A patient is much safer if one yard of intestine has been sacrificed unnecessarily, than he would be if the excision were made at the very border of the gangrenous tissue.

Technique.

In excising diseased intestine it is well to grasp the mesenteric vessels carefully as one progresses and to ligate them before resecting the intestine. In case it does not seem safe to apply simple ligatures the mesentery may be transfixed with sutures, in order to prevent slipping.

After a sufficient amount of intestine has been separated from its attachment to the mesentery, care is taken to stop at a point sufficiently distant from a large branch of the mesenteric artery to prevent the injury of the latter. The intestine is now held on either side by the hand of an assistant to prevent leakage, or this may be done by passing a narrow strip of gauze through the mesentery and tying just tightly enough to prevent extrusion. Then a large pair of long-jawed, clamp forceps is applied to either side of the portion to be excised, in order to prevent leakage from this portion. Then the intestine is cut away at either side, care being taken to cut away a little more from the point opposite the mesentery than on the mesenteric side.

Aside from protecting the tissue against gangrene this method results in a little increase in lumen at the point at which the enterorrhaphy is made, which is probably of importance especially in cases in which this is accomplished by the suture method. When the Murphy button is used there is never any narrowing at the point of union, because the cicatricial tissue formed is so slight that it can hardly be discovered by the unaided eye.

Silk stitches are then applied, as illustrated in Plate XXXII, being cautious to pass the stitch around the mesentery so as to hold its two surfaces together. The larger segment of the Murphy button is adjusted to the lower segment and the smaller one to the upper and then the two segments are adjusted to each other. It is well to turn them a little so that the mesentery of the one part does not fall directly opposite to the mesentery of the other. A few sutures should be applied to cover the defect caused by the excision of the intestine in order to prevent unnecessary adhesions to the denuded surfaces.

In this operation we now use the suture method exclusively, applying one row of sutures which grasps all of the layers to secure accurate coaptation and to control the hemorrhage. This row of sutures carefully brings

together the mesenteric attachment so as to prevent leakage at this point. A second row of continuous Lembert sutures is applied over the first row of sutures in order to unite peritoneum to peritoneum throughout. This method was introduced by Czerny many years ago and is still very satisfactory.

Gregory Connell has introduced the following method which is also most excellent although it requires somewhat more dexterity and accuracy than that just described.

The Connell Method.

Nothing can be more perfect for an end-to-end anastomosis of the small intestine than this operation when performed by its author or by any one who has operated sufficiently often upon animals to obtain a similar degree of accuracy. Each successive suture leaves the serous surfaces in ideal coaptation, as shown by the accompanying illustrations, and when the operation has been completed every suture is perfectly buried. There can be no hemorrhage because the sutures grasp every portion of the intestinal wall. The mesenteric attachment has been closed so that there can be no perforation at this treacherous point and there is no possibility of obstruction at the point of union between the two segments. The operation is, however, too difficult technically to be undertaken by an unskilled surgeon, who might still be able to safely close both ends of the intestine and make the lateral anastomosis described above.

Steps of the Operation.

The various steps of the operation have been so accurately described by Gregory Connell, its author, in connection with his illustrations that it seems impossible to misunderstand any detail, and in order to acquire the necessary skill to perform this operation it is but necessary to do it repeatedly upon dogs.

A dozen operations can safely be made upon a single animal if the surgeon will work as rapidly as he can, and if ether is administered carefully to the animal it consequently will not require many animals to acquire proficiency.

The excision of the diseased portion having been made and the bleeding from the mesenteric attachment controlled the first suture is applied from within outward, indicated in Fig. 1, Plate XXXV, just outside of the mesenteric attachment, then it is carried across to the other side and passed from without inward again just outside of the mesentery, then it is carried across to the other side and is passed into the lumen of the intestine where the suture is tied, perfectly closing the mesenteric attachment. The sutures from this point on are applied as indicated in the illustrations, on Plates XXXV and XXXVI.

RESECTION OF THE COLON.

Should it become requisite to resect the colon we are confronted with a condition which is somewhat different, inasmuch as the posterior surface of the colon is not covered with peritoneum. This makes an anastomosis much more troublesome, because union is much less certain in portions of the intestine not covered with peritoneum. In order to overcome this difficulty it is best to close the ends of the colon and make a side-to-side anastomosis of the two ends, choosing for this the surfaces covered with peritoneum, as illustrated in Plate XXXIII.

In the transverse colon it is especially important not to infringe upon



1 Insertion of mesenteric suture, which obliterates triangular space



2 Mesenteric suture, and stitch at convex border inserted and tied, with ends left long for traction. Intervening stitches in place



3 First, posterior, half completed, with first stitch in second, anterior, half inserted, ready for tying



4 Stitches similar to one shown in Fig 3, inserted throughout the anterior half, all tied but the last stitch. This in place, with ends ready for tying.



5 Threaded needle is inserted eye first between two stitches into the lumen, at a point in the circumference about opposite to the stitch to be tied

PLATE XXXV

Illustrating the Connell Method of Suturing (Courtesy of Gregory Connell)



1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100.



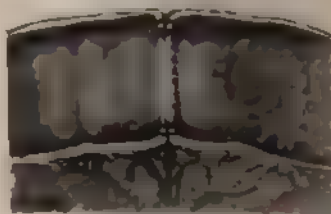
6 The threaded needle presents at the location of the last stitch. The ends to be tied are inserted into the loop formed by the needle and its thread.



7. By withdrawal of the needle and its loop, the cut ends at the site of the last stitch are inverted, and the ends to be tied are drawn to the outside through the opposite portion of the line of suture.



8 Traction on suture ends causes the site of the future knot to come in contact with the mucosa of the opposite side of the bowel. The ends are tied, the knot sinks between the previously inserted stitches and is located on the mucosa



9 The last knot is tied, the bowel has resumed its cylindrical contour, and the enterorrhaphy is complete, with all knots in the lumen.

PLATE XXXVI

Illustrating the Connell Method of Suturing (Courtesy of Gregory Connell)



the attachment of the omentum for fear of causing subsequent necrosis. This anastomosis should never be made by means of a Murphy button, as there is liable to be an accumulation of hardened feces in the upper segment, which would be likely to obstruct the lumen of the button, for this reason it seems best always to make an anastomosis by means of suturing. It is usually still better to close both ends of the large intestine and make an anastomosis between the ileum and the colon below the point of resection, as in this way one secures the flow of liquid contents of the small intestine into the colon. In this case the button is perfectly safe but we now always use the suture.

If this plan is followed it is best to excise all of the colon on the proximal side of the malignant growth to prevent accumulation of fecal material in this portion and it is usually most convenient to make the anastomosis between the ileum and the sigmoid flexure, because at this point the anastomosis can be effected without any tension upon either segment.

The end of the colon is closed by applying a strong pair of forceps across the intestine at the point at which the resection is contemplated. This will crush the soft tissues out of the grasp of the forceps and leave only the fibrous tissue in place. Then a silk purse-string suture is applied to the proximal side of these forceps. This is tied tightly, which will cause it to be buried in the groove made by the heavy forceps. Then the diseased portion is cut away, leaving the portion of the tissue held by the purse-string suture to project from the part of the intestine which is left. This is then buried in the end of the intestine by the application of a row of Lembert sutures.

Gibson Method.

The most satisfactory operation for end-to-end anastomosis of the lower end of the colon that we have employed is that introduced by C. L. Gibson which we will describe in his own words.

The method has the advantage of extreme simplicity. It provides for a broad union of peritoneal surfaces and it reduces the tension necessary to a minimum.

The anastomosis does not result in any narrowing at the line of suturing.

"The upper cut edge of the gut is seized with two Kocker clamps and introduced by these into the lumen of the lower end and maintained there by an assistant. The extent to which it is feasible to accomplish this invagination will vary, depending on the laxity of the mesentery. If the latter is very short it may be elongated somewhat by a generous incision of its outer layer. As a general rule I should wish to carry the cut end of the upper segment so far down as possible, hoping more efficiently to direct the fecal current away from the suture line. The gut is rotated about a quarter circle so that the non-peritoneal covered surfaces do not entirely approximate in the circumference. Eight to twelve interrupted silk sutures are introduced thus. A Lembert suture is begun on the lower segment, the needle issuing just short of the cut edge; on the upper segment the needle is introduced just above the line where the cut edge of the lower segment lies against the intact wall of the upper. When the knot is tied the free cut edge has been turned inward and only the peritoneal surfaces are in contact. A continuous running suture is applied over this area further invaginating the first ones, the Kocher clamps being previously withdrawn."

After Treatment.

In a general way the after-treatment in which the colon is involved in

the operation is the same as in operations upon the stomach or the small intestines; only predigested foods are given by mouth from the third day on and nourishment by enema is not employed. Hot water in small sips is given by mouth shortly after the operation and continued for the first few days.

One can easily choose a predigested food which is absorbed almost entirely from the stomach and small intestines which will sustain the patient until the union between the joined ends of intestine is sufficiently firm to make the use of general liquid diet safe. Ordinarily a very firm union exists after the third day, but occasionally the patients in whom these operations are indicated are much reduced in strength and consequently their tissues do not heal so rapidly.

INGUINAL COLOSTOMY.

The only pathological condition indicating an inguinal colostomy is a stricture of the rectum which cannot be excised. This may be due to carcinoma or cicatricial contraction following a tubercular or a syphilitic ulcer, or an acute infection.

The operation may be intended only for temporary relief until the constricted portion of the rectum may be excised and the continuity between the intestine above and below this constriction has again been established, or it may be for permanent use. If it is intended only for temporary effect it is not necessary to provide for a means of keeping this opening closed at times to guard against the involuntary evacuation of the bowels. If the intestine is, however, intended to remain permanently open, it is desirable to secure such a provision. For the sake of brevity we describe only the latter operation, because it happens frequently that a colostomy which is primarily intended to be only for temporary relief will later be maintained permanently, either because it is not possible to establish a satisfactory communication through the natural way, or because the patient is so comfortable that he refuses to submit to the necessary operation to establish the communication through the rectum.

Technique.

An incision is made parallel with Poupart's ligament, two and one-half inches in length, two inches above the anterior superior spine. Its center is crossed by a line extending from the left anterior superior spine of the ilium to the umbilicus. This line extends down through the external oblique abdominal muscle, whose fibers it separates but does not cut.

The internal oblique abdominal muscle is then separated in the direction of its fibers, which extend nearly at right angles with the fibers of the external oblique. Then the transversalis fascia and peritoneum are severed in the same direction. This incision corresponds exactly to the McBurney incision, which has been described in the section on appendicitis, with the exception that it is on the left instead of the right side of the abdomen. With this incision the two abdominal muscles are not impaired, because none of their fibers have been cut at right angles, and they are in a condition in which they can readily act as sphincter muscles.

A second incision is now made parallel with the first and of the same length, but four cm. nearer the anterior superior spine of the ilium. A third incision uniting these two at the upper end is made and the flap of the skin thus formed is dissected loose and covered temporarily by a piece of moist



END-TO-END ANASTOMOSIS OF COLON.

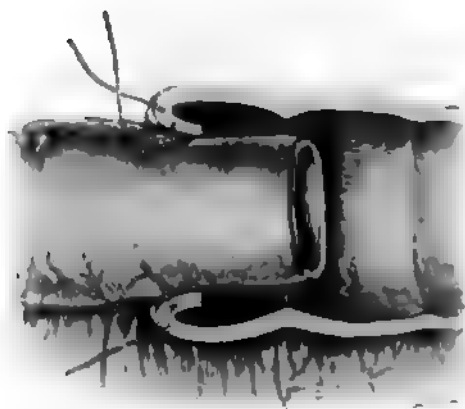
1. The intestine is clamped with large forceps whose jaws are covered with rubber tubing to prevent injury to tissues. By courtesy of Dr. C. L. Gibson.



END TO-END ANASTOMOSIS OF COLON

2. The upper segment is invaginated into the lower and a Lembert suture has been applied which will invert the cut end of the lower segment when tied. By courtesy of Dr. C. L. Gibson





END-TO-END ANASTOMOSIS OF COLON.

3. The compressing forceps have been removed and the cut end of the lower segment inverted. By courtesy of Dr. C. L. Gibson.



END-TO-END ANASTOMOSIS OF COLON

4. The completed operation with exception of tying sutures and introducing further sutures of the same kind. By courtesy of Dr. C. L. Gibson.



antiseptic gauze. The finger is then inserted into the abdominal cavity and passed along the ilium until it reaches the sigmoid flexure of the colon. This is withdrawn through the incision in the abdominal wall. It can readily be recognized as large intestine from the fact that the longitudinal band of muscle fibers extends parallel with its upper surface and that there are attached to it numerous masses of fat, the appendices epiploica. It is best to bring out the upper segment of the sigmoid as much as possible, in order to prevent it from prolapsing later on, a condition which occurs frequently in cases in which this precaution has not been taken.

The intestine is now held up to the light in order to select a point in its mesentery through which an opening may be torn without disturbing any of the large blood vessels. This opening must be sufficiently large to admit the skin flap which has been prepared. The upper segment of the intestine is then placed outward and the lower segment inward and the skin flap is drawn through the opening in the mesentery. In this manner the upper segment is bent over the outer edge of the abdominal wall and underneath the skin flap. Consequently, after healing has taken place the application of a pad over this part will cause the skin flap to act like a valve and will prevent the involuntary evacuation of the bowel contents. The incisions are now closed. In order to prevent any protrusion, a few stitches are inserted attaching the intestine to the skin. The operation is shown in Plate XXXIX.

The loop of intestine is not opened until adhesions have formed, unless this is necessary on account of complete obstruction, in which case the wound is carefully protected and a large rubber tube covering a short glass tube is inserted into the upper segment and securely fastened by means of a strong purse-string suture. This will compel the contents of the intestine to pass out through the tube, which is passed through the dressing, without soiling the wound. If this is not necessary a dressing is applied which will permit the gas to pass through this loop. Cotton is rolled in long bundles and these are applied about the protruding intestine after the fashion of logs in a log cabin. These bundles are held in place by means of broad adhesive strips and an abdominal bandage.

After from two to five days the intestine is cut across and then the evacuations can occur without interfering with the healing of the wound. Aside from the advantage there is in securing a means of closing the upper segment when desired, this method has the further value of leaving the two openings of the intestine so far apart that there can be no passage of feces from the upper into the lower. The evacuations will now occur through the opening a, which is sufficiently separated from the opening b, communicating with the segment leading to the rectum, to prevent any of the evacuations from finding their way into this canal. This portion of the intestine can, however, be cleansed by irrigating through this opening.

In case it should become desirable later on to close the artificial anus this may be accomplished by inserting one branch of a clamp through each of these openings and gradually tightening the pressure until a communication has been established, when the openings can readily be closed.

After Treatment.

Until the protruding loop has been cut only hot water and small quantities of predigested food are given by mouth. After this time general liquids, and after a week light diet is given.

This operation is usually performed in old persons greatly reduced in

strength and such do not well bear lying quietly in bed. It is consequently best to permit them to occupy a semi-sitting position within a day or two after the operation, and to leave the bed within a week or ten days later.

After the intestine has been opened a cathartic, preferably castor oil, should be given, and this should be followed by several enemata in order to remove fecal accumulations which frequently exist in large quantities above the constriction, even if a diligent attempt has been made to evacuate the bowels before the operation. Frequently the lower segment contains many of these masses, which may usually be removed by irrigation but may occasionally require a blunt scoop. It is well to examine the opening by inserting the finger within the lumen of the intestine through the abdominal wall, because occasionally not sufficient space has been allowed for the evacuation of the bowels and the free passage of gas. This can be remedied readily by a slight incision.

These patients should be instructed to regulate their diet so as to avoid constipation and then to take a simple cleansing enema once a day to insure a free evacuation of the bowels. Thus they can usually be entirely free from any annoyance because of the artificial anus. A small pad of cotton should be worn over the opening, held in place by a simple abdominal bandage. In case there is any annoyance from escaping feces a substantial pad may be held in place over the opening by means of an elastic bandage, which will compress the intestine underneath the skin flap Plate XXXIX c, over the edge of the abdominal wound sufficiently to overcome this annoyance.

If there is not enough force in the colon to produce an evacuation, it is sometimes best to insert a large rectal tube after giving the enema and to effect the evacuation through this.

In cases in which it is plain at the time of the operation that it will never be possible to re-establish communication between the upper and lower segments, on account of the obstruction in the rectum, we prefer to perform an operation which carries out the upper segment through the abdominal wall. This is required especially in cases of carcinoma in which the growth has invaded the surrounding tissues to such an extent that a complete removal is impossible.

In this operation the first steps are the same as those described above but instead of forming a skin flap to carry underneath the loop of intestine the second incision, five cm., is made parallel to the first and the skin and superficial fascia are undermined so as to form a tunnel through which the upper segment of the colon is later to be carried, then the abdomen is opened a second time through a median incision ten to fifteen cm. long between the umbilicus and the pubis. The sigmoid flexure is brought out through this opening, its mesentery is clamped and ligated according to the method described in excision of the colon. About ten to fifteen cm. of the intestine is made free from the mesentery, then two large clamps are applied transversely, at a point leaving enough tissue in connection with the lower segment to make sure that the upper segment is at least ten cm. beyond any diseased tissue and at the same time enough to make an inversion of the free end of this segment into its lumen easily possible. The upper segment must contain a sufficient amount of free bowel to reach through the inguinal opening and through the canal underneath the skin flap, and beyond the margin of the second incision, without the slightest tension.

The end of the lower segment is then ligated and inverted into its lumen



PLATE XXXIX

INGUINAL COLONSTOMY

The colon is drawn out through the incision in the abdominal wall. The temporary is split, a rectangular flap of skin is cut and drawn through the slit in the temporary and sutured in place. The longitudinal muscular band is shown upon the surface of the sigmoid flexure of the colon.

The intestine will be cut across at the point indicated by the dotted line. The openings will then retract to the points a and b.

and the wall closed over it with a purse-string suture which is reinforced with a row of Lembert sutures.

The upper segment is then also ligated to prevent the escape of any contents, then it is carefully covered with gauze and carried out through the inguinal incision and underneath the skin flap where it is sutured in place, so as to project at least one cm. beyond the surface of the skin. A few sutures are applied between the wall of the bowel and the peritoneum and transversalis fascia at the inguinal wound in order to support the segment and at the same time to prevent any loop of the small intestine from being forced out along the side of the colon.

Then the wounds are all sutured and the same dressing is applied as in the previous operation.

It is important to determine which is the proximal and which the distal segment because in these cases with long-continued obstruction the sigmoid flexure is often very long and sometimes twisted upon its mesentery so that it is quite possible to confound the two segments. This would, of course, be a fatal error unless it were discovered in time to be remedied.

The after-treatment is the same as in the previous operation, the ligature closing the upper segment is removed on the second or third day. It is important in this operation not to permit any fecal matter to remain in the lower segment above the point of constriction, as this might result in perforation.

In many of these cases the removal of irritation caused by the passage of fecal material over the surface of the carcinoma will cause the malignant growth to remain stationary in its development for a long time.

We have seen many of these patients take on a normal appearance, gain greatly in weight, return to their occupation and imagine themselves cured for months or even years. This is true especially in cases of very slow growing annular carcinoma of the rectum in which the bad condition of the patient is due to prolonged absorption of fecal material which had accumulated above the seat of obstruction before this condition was relieved by establishing a colostomy.

ARBUTHNOT LANE'S SURGICAL TREATMENT FOR CONSTIPATION.

Several years ago our attention was directed by Lane to the fact that many patients suffer severely from the results of absorption of putrid substances from a colon containing enormous quantities of fecal matter prevented from being evacuated normally. Lane demonstrated the fact that these accumulations remain indefinite periods of time, the evacuations that may occur from time to time never emptying more than the lowest portion, and frequently passing directly by the accumulations in the colon on their way from the ileum to the rectum.

This condition is due to faulty development as regards the position especially of the cecum and transverse colon, the latter usually having its position low down in the abdominal cavity. It is further exaggerated by constricting or obstructing bands, and still further by habitual neglect on the part of the patient to secure regular, complete daily evacuation of the bowels.

When the transverse colon and the cecum have once become permanently loaded with hardened feces the weight of the mass itself will result in the dropping down of the cecum and transverse colon, and this in turn will serve to still further increase the condition of constipation.

In many of these cases Lane has obtained remarkable results, restoring patients who were complete physical and nervous wrecks to good health and strength by excising the entire colon and implanting the ileum into the sigmoid or into the upper portion of the rectum; or in milder cases by resecting the ileum fifteen cm. from its entrance into the cecum and implanting the proximal end into the sigmoid flexure.

The following description of the various steps of the operation is taken from Lane's work on this subject. We have performed the operation three times with satisfactory results and have seen a number of Lane's patients, all of whom showed excellent recoveries.

Lane's Technique.

"In no circumstances should operative interference be contemplated till the surgeon has satisfied himself that every other means of treatment have failed, whether medical or mechanical.

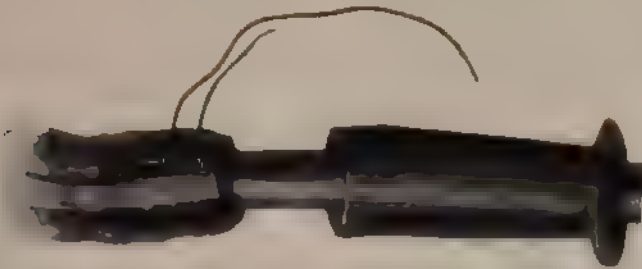
"In the treatment of such degrees of overloading of the large bowel as cannot be treated efficiently by measures short of operation, I have obtained considerable success by dividing constricting bands and adhesions, and by subsequent careful attention to the proper functioning of the bowel. In a considerable proportion of cases, and more particularly in women, such means are insufficient, as at the best they only afford temporary relief. since the obstruction recurs sooner or later.

"In my earliest cases, after the appendix had been removed and the cecum and flexures freed from adhesions on one or more occasions, with transitory benefit, I looked about for some means of relieving the patients of the cecal pain from which they suffered and for the relief of which they were ready to submit to any operation. Pain was the chief symptom of which they complained.

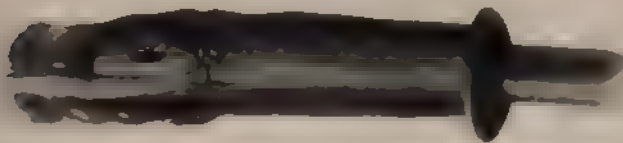
"In the first case I merely made a lateral anastomosis between the ileum and sigmoid, but the early return of cecal pain obliged me to divide the ileum. In several of the cases in which I had divided the ileum, after an interval of months the patients were occasionally annoyed by the presence of hard, dry masses of fecal matter in the cecum. They produced no auto-intoxication, but the discomfort arising from their presence and from flatulent distension was sufficient to call for the removal of the large bowel as far as the splenic flexure. These hard masses of feculent material are not necessarily the result of regurgitation, but are probably formed in the large bowel. A still more extended experience showed me that if any portion of the large bowel is left above the junction with the ileum it tends to dilate sooner or later. This dilatation may interfere with the satisfactory evacuation of feces, and discomfort or pain may ensue because of its distension by fecal matter or gas. Therefore, to overcome completely the constipation as well as the septic absorption, the large bowel should be removed as far as its junction with the ileum, which is effected in the upper part of the rectum or in the adjacent sigmoid.

"Therefore, when I recognize that the mechanics of the intestines have been altered to a degree that cannot be rectified satisfactorily by the division of bands, etc., I divide the ileum at a distance of about five or six inches from the cecum. This can be done rapidly and securely by encircling it by means of a catgut ligature.

"The ileum is divided by the cautery immediately beyond the ligature. The stump is then buried in the proximal bowel by means of a purse-string



1. Showing tube introduced through the rectum up into proximal sigmoid, and placing of catgut suture



2. Showing tube used for bringing the two ends into apposition, and first row of sutures placed.



3. Showing tube used for bringing the two ends into apposition, and first row of sutures placed.

suture which encircles the bowel and perforates its peritoneal and muscular coats about three-quarters of an inch above its ligatured extremity, rendering the closure absolutely secure.

"The acquired adhesions and peritoneum which bind the cecum and ascending colon to the abdominal wall external to them are divided, and the bowel is raised till the vessels which supply it are exposed. These are grasped in compression forceps and firmly ligatured. The vessels supplying the transverse colon are similarly treated, and finally the descending colon and perhaps the sigmoid are removed, the upper limit of the rectum or the lower part of the sigmoid being occluded in the same manner as the ileum.

"Originally I had been satisfied to divide the transverse colon at the splenic flexure, closing the distal portion in the manner already described, but for the reasons I have given I now remove the descending colon and a portion or the whole of the sigmoid, closing the large bowel at, or just above, its junction with the rectum.

"The termination of the ileum and the sigmoid or rectum adjacent to it are brought into convenient opposition, and a perfectly secure and reliable lateral anastomosis is made by means of a double row of continuous sutures, the inner row of which perforates all the coats, while the outer does not enter the lumen of the bowel.

"If the surgeon prefers it, the ileum and rectum may be united end-to-end. This is the ideal way, since any tendency to pouching which exists in the case of lateral anastomosis is avoided. The objections to it is that it is not so safe because of the difference in the circumference of the two pieces of bowel, the frequent very great tenuity of the wall of the ileum, and the difficulty occasionally met with in dealing with the mesenteric attachment.

"Subsequent dilatation of the ileum beyond the seat of lateral anastomosis may be avoided by sewing down and obliterating the lumen of the distal gut right up to the aperture of communication with the large bowel.

"Finally, a fine gut ligature is passed through the free incised margin of the mesentery of the ileum, and then beneath the peritoneum forming the outer wall of the meso-rectum. This, when made tight, brings the rectum to the middle line of the pelvis and fixes it securely in that situation immediately beneath the position occupied normally by the divided end of the ileum. The ligature also closes the interval between these two mesenteries, through which a loop of bowel might otherwise pass and give trouble.

"There are many cases in which the patient is unable to sustain the strain of the removal of the large bowel, but can that of division of the small bowel and the establishment of a connection between it and the sigmoid or rectum. This operation relieves the patient of the toxemia.

"Should the symptoms resulting from the distension of the colon cause sufficient trouble the large bowel can be removed at a later date with much less risk.

"Again, there are a number of cases of extreme toxemia, who have no pain, and in whom the division of the ileum and its connection with the end of the large bowel is sufficient, since it relieves the patient of all trouble.

"The stomach is exposed and is usually found to be dilated to a varying extent. In this condition the pylorus is hung up by adhesions to the liver and gall-bladder. These are freely divided. I have employed gold leaf to obviate the re-formation of adhesions with apparent advantage. The adhesions tend to re-form since the mechanical factors determining their development continue to exist. When the weight of the transverse colon has

been removed, during the period of recumbency following on the operation, the dilatation of the stomach usually disappears more or less completely. On several occasions after a varying interval from the operation of resection of the large bowel, the dilatation of the stomach has become a feature of sufficient importance to require its more effective drainage by a gastro-enterostomy. This operation has afforded complete relief of the gastric symptoms. I have seen cases of chronic intestinal stasis in which a gastro-enterostomy alone had been done for dilatation of the stomach with very distinct disadvantage to the patient. The surgeon has not recognized the sequence and he has brought the operation of gastro-enterostomy into disrepute. Indeed, I have seen it frequently stated that gastro-enterostomy is of no service unless there be obstruction to the pylorus by growth or cicatrix. To attempt to relieve symptoms by performing a gastro-enterostomy in the first instance in the dilatation of the stomach that follows upon chronic intestinal stasis is of little or no avail."

CARCINOMA IN THE UPPER PORTION OF THE RECTUM.

If a carcinoma is located in the upper portion of the rectum it is often impossible to approach it from below, but it can be removed with ease through an abdominal incision. This operation is indicated only if the tumor is confined entirely to the intestine, because if the surrounding tissues have been invaded the removal of the tumor would in no way retard the progress of the disease.

Technique.

Under favorable conditions, then, the following operation is indicated: The patient is placed in the exaggerated Trendelenburg position. An incision is made through the linea alba extending from the pubis to a point an inch below the umbilicus. The intestines are held away by means of moist gauze tampons. The sigmoid flexure is then found and grasped between two pairs of long-jawed pressure forceps placed side by side at a sufficient distance above the tumor to make sure that every portion of the growth is several inches below the lower pair of forceps. The intestine is then severed between these two pairs of forceps and a second incision is made in the left inguinal region, corresponding to McBurney's incision for the removal of the vermiform appendix only upon the opposite side, care being taken to separate the fibers of the external and internal oblique abdominal muscles, as described in the previous operation. A pair of long-jawed pressure forceps is then passed through this opening and attached to the upper segment, which is withdrawn through this wound and carefully sutured to its edges, after a large rubber tube surrounding a glass cylinder has been inserted in this segment and fastened in place by means of a purse-string suture. This will permit the escape of gas and feces without any danger of soiling the abdominal wound. The pair of forceps upon the lower segment is lifted toward the abdominal incision and the posterior attachment of the intestine below these forceps is successively grasped by means of pressure forceps, and as the attachment is grasped the intestine is cut loose. In this manner the entire intestine can be loosened without the slightest danger of hemorrhage. If the diseased portion is not extensive two other pairs of pressure forceps are placed parallel to each other at a sufficient distance below the tumor to insure its complete removal. The intestine is cut off between these



PLATE XLI

Profile drawing of median section of the pelvis, showing completed anastomosis

two forceps and the tumor removed, together with the forceps above and below it. A purse-string stitch is applied around the lower segment, and the edges caught by means of the pressure forceps are inverted. Then the entire abraded surface is covered with peritoneum and the abdominal wound closed. Occasionally the sigmoid flexure is so long and its attachments so loose that it is possible to withdraw the upper segment through the lower segment and treat according to the method introduced by Gibson, which has already been fully described.

At this point we wish to emphasize the fact that it is most important to make a free excision of these tumors, and that in no case should one make a less thorough operation for the sake of maintaining the natural instead of the artificial anus.

INTESTINAL FISTULA.

Causes and Incidence.

Intestinal fistulæ at the present time occur most frequently after operations performed for the relief of acute appendicitis complicated by the formation of extensive abscesses. The fistulæ are more common in cases in which the appendix itself has not been removed, or in which the appendix has been removed at an inappropriate time or with extreme manipulations. The condition also occurs after other operations in which the intestinal wall has been injured either by disease or by the operation, or by the drainage tube which was applied after operation. It is more common after operations which have been performed for the relief of inflammatory conditions, such as pyosalpinx. It also occurs after operations for strangulated hernia and after those for the resection of any portion of the intestinal tract. After operations for the relief of tubercular peritonitis, in which the adhesions between loops of intestines have been separated, intestinal fistulæ frequently occur; they also follow direct injury to the intestinal tract.

Spontaneous Cure.

A considerable proportion of intestinal fistulæ will heal if absolute rest is secured as nearly as possible. This may be accomplished most readily by first emptying the alimentary canal thoroughly by means of large, repeated doses of castor oil, which will remove not only the food, but also all mucus contained in the canal. The fistulæ should be thoroughly cleansed by irrigation. This should be followed by feeding the patient exclusively by means of nutrient enemata. In this manner the intestinal canal may be kept relatively empty for a number of days, and in the meantime the openings in the intestine are likely to decrease in size unless there is a marked eversion of the mucous membrane. If this condition is present nothing but a radical operation will bring relief. The same is true if there is a stricture or narrowing of the intestinal canal distal to the fistula. Occasionally this will prevent the healing of an intestinal fistula which would otherwise respond readily to treatment.

Operative Technique.

It is usually wise to postpone the operation until the course above described has been thoroughly tried, because one will frequently succeed by the simpler method even after the fistula has existed for a considerable time, and this is especially true of fistulæ in portions of the colon where the bowel is covered with peritoneum.

The incision through the abdominal wall should be made at some distance from the fistula so as to avoid the adhesions which one is sure to encounter at the point where the abdominal wall is penetrated by the fistula. The amount of traumatism necessary for performing the operation required is very much reduced if this precaution is taken, because the conditions may be determined much more perfectly if the abdominal cavity is opened at a point quite away from these adhesions. The incision should be sufficiently long to permit of performing the entire operation in full sight.

After the abdominal cavity has been opened all of the intra-abdominal organs should be tamponed away from the portion of the intestines involved, then these should be loosened from the abdominal wall and carefully brought out so that all abrasions upon their surfaces may be carefully repaired. Attention is then given to the fistula itself. In cases following appendicitis operation the fistula most frequently enters the appendix at the point at which that organ was perforated during the acute attack. All that needs to be done in such instance is to remove the entire appendix after the methods described heretofore. In these cases the method of separating the appendix first from its cecal end and then dissecting it out distally is especially useful. It may be dissected out together with the fistula. The abraded surfaces upon the intestines which have been adherent must be carefully covered with peritoneum. It is usually well to pass a drain through the opening in the abdominal wall through which the fistula extended down to the seat of injury in the intestine, and then to completely close the new opening in the abdominal wall. If the fistula is in the cecum it is usually not difficult to close it by means of sutures if the following points are borne in mind:

- 1st. The tissues to be sutured must not be eicatricial in character.
- 2nd. The sutures must be applied with great accuracy so as to have a perfect coaptation of surfaces.
- 3d. The sutures must not grasp too large an amount of tissue.
- 4th. The entire line of sutures when completed must be covered with healthy peritoneum or with a piece of omentum.

A drain should be placed down to the point of suture as described above.

In fistulæ of the small intestines it is usually advisable to make a resection of a considerable portion of the bowel, in fact, a sufficient amount should be removed to make the anastomosis between the ends in entirely healthy tissue. This can then be accomplished by means of the Murphy button, as described before; or by means of the continuous or interrupted intestinal suture, also described; or the ends of the intestine may be closed and a lateral anastomosis may be made after the method already outlined, which is the safest, as a rule. In any event the important point to be borne in mind is that the operation must be done entirely in healthy tissue. The loss of a number of feet of small intestine is of practically no importance to the patient, but if too little is taken away for the sake of saving a small portion of intestine a subsequent perforation is liable to occur.

Fistulæ following operations for the relief of tubercular peritonitis can usually be healed only if the tuberculosis affects but a relatively small portion of the intestine which can be removed *in toto*. In this case the same conditions obtain which have just been described. If the tuberculosis is not relatively circumscribed then these fistulæ can virtually never be cured.

Occasionally an intestinal fistula is complicated by such extensive adhesions that it seems unsafe to loosen them, and it then may become necessary to make a lateral anastomosis between the intestine going toward the

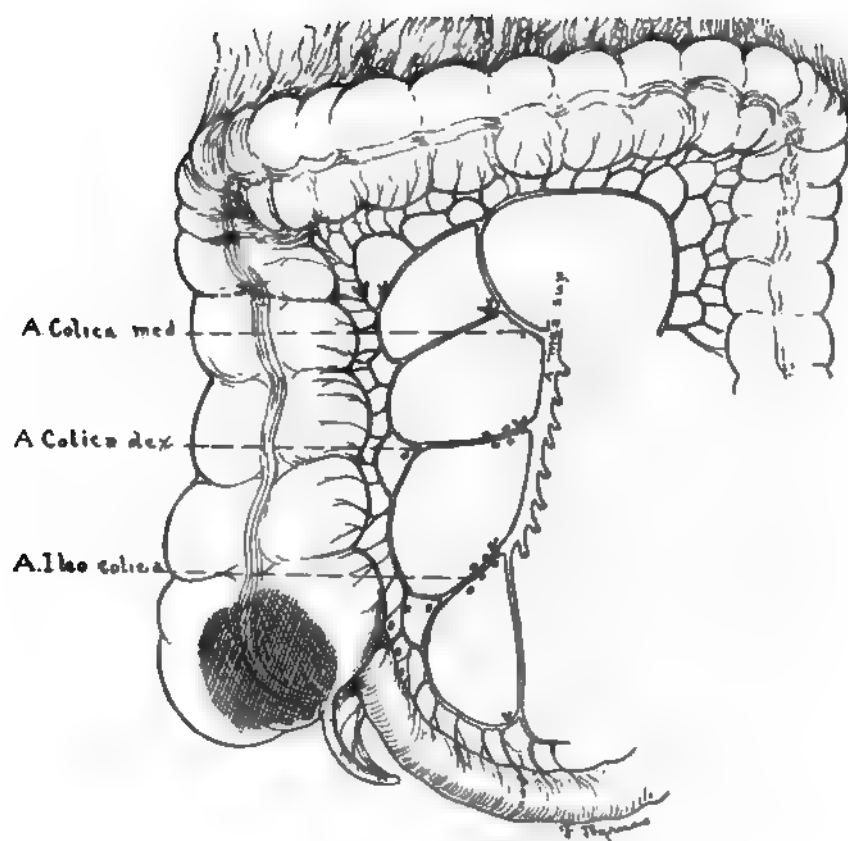


Fig. 16.
Carcinoma of cecum. Dotted lines showing lines of resection. (Mayo.)

fistula and that coming from it in order to short-circuit the gut at this point. It is best to pass a silk purse-string suture about the portion of bowel to be eliminated just beyond the anastomosis, in order to prevent intestinal contents from entering this portion. The suture should be applied subperitoneally and tied just tightly enough to accomplish this end without causing pressure necrosis.

INTUSSUSCEPTION.

This is encountered usually in very small children although it occurs occasionally in children ten years of age or even older, and it may happen in the adult, but so rarely that we have never seen such an instance. Our eldest patient was not more than twelve years of age, while we have treated many children between one and four years of age.

Typical Case.

The child is sixteen months of age and had been perfectly well until six hours ago when she suddenly began to complain of severe colicky pain in the abdomen. She desired to evacuate her bowels but was unsuccessful. Half an hour later a second attempt was unsuccessful and an enema which was given in the hope of relieving the condition came away clear, although a slight amount of mucus was expelled directly after. From this time on the patient has had repeated attacks of pain, very severe, causing the child to cry out and draw its thighs upon its abdomen.

The family physician, who was called, gave an enema and a mild sedative and advised the use of calomel later on in case relief should not come. A second physician was called and applied hot fomentations to the abdomen and recommended consulting a surgeon later. The pain becoming constantly more severe and the parents having had experience the previous year with a case of acute perforative appendicitis in a child two years older, the consultation was arranged for promptly.

Present Condition.

The child being undressed we find a well-nourished, perfectly healthy appearance, with excellent color and well formed body. Lungs and heart are normal. While inspecting the abdomen a bulging appears opposite the middle of the right rectus abdominis muscle, at the same time the child draws its thighs up over the abdomen and begins to cry, evidently because of severe intra-abdominal pain.

All of these symptoms subside in about two minutes. Palpation of the abdomen reveals a hard sausage-like body to the right and a little above the umbilicus in the region normally occupied by the hepatic flexure of the colon. The abdominal muscles over this mass are somewhat tense. Nothing else abnormal can be discovered. Some mucus which has been expelled is slightly streaked with blood. Upon again questioning the nurse the fact that the child fell from a foot-stool upon the carpet early in the afternoon was elicited, but as the child had arisen at once and had not complained the matter had not impressed itself upon the maid until she was questioned specifically. The child had taken a little water since the time of the fall but no food.

The second physician had made a diagnosis of intussusception which we confirmed at once upon making the examination just described. The child was brought to the hospital at once and we will make an abdominal section

without any delay, because all of these cases operated within the first twenty-four hours after the beginning of the attack have made a perfect recovery, while those in whom the operation had been delayed longer showed much less favorable results.

The patient will be immediately anesthetized with ether, then the skin covering the abdomen will be disinfected in the usual manner and then we will split the right rectus abdominis muscle longitudinally at a point opposite the umbilicus by an incision fifteen cm. long, dividing the muscle as nearly as possible into halves. It is best to make the incision sufficiently long to prevent trauma to the intestine during the subsequent manipulations.

The cecum, a portion of the ileum and the vermiform appendix have been telescoped into the transverse colon. Seeing this mass before you there is temptation to seize the ileum and make traction upon it for the purpose of reducing the intussusception. Experience has shown, however, that such a course is not proper, because it seems to wedge the inner intestine more tightly to the outer one; while by pressing upon the outer surface of the colon just beyond the point to which the inner gut reaches the latter may be readily pushed back until the whole length of intestine is again free. A careful inspection of the cecum, transverse colon and ileum shows that no necrosis and no abrasion has taken place. Had the intussusception remained for twenty-four hours or longer some points of gangrene and some areas of abrasions would surely be discovered. Still later a large portion of the intestine becomes gangrenous. Occasionally such a gangrenous intestine will slough away entirely and be expelled through the rectum, the two portions beyond this segment uniting spontaneously, but much more frequently the condition results in a fatal peritonitis.

Upon inspecting the vermiform appendix we find that it is fourteen cm. long and that it forms a constricting band around the ileum just outside of the ileo-cecal junction. It is likely that when the child had its fall the appendix was thrown around the ileum in this abnormal position and that the constriction caused by the appendix at this point was the exciting cause which produced the invagination.

We will remove the appendix in the usual manner and close the abdominal wound.

During the entire operation there has been but very little manipulation of the intra-abdominal organs, and it seems reasonable to expect that this patient will recover without shock or sepsis.

After Treatment.

The patient will be kept quiet, she will be nourished for four days by nutrient enemata, then broth will be given by mouth. Small cleansing enemata will be employed to evacuate the bowel. No cathartics will be allowed for one month. Only such food will be given as can be easily digested without producing much residue.

In cases that come under surgical treatment later, after the intestine has become gangrenous, it is best to excise all of the bowel involved in the intussusception, after the method described for excision of the colon with a part of the ileum.

Frequently by first making an attempt at reduction of the intussusception in late cases the peritoneum is so severely infected that the patient dies of diffuse peritonitis, while he would surely have recovered had these useless manipulations been omitted.

In making this excision it is well to remember that it is even more likely to injure the duodenum in this operation than in the simple excision of the ascending colon, but if the surgeon's attention has been directed to the fact it is not difficult to avoid this complication.

VOLVULUS.

Another common condition, which, like intussusception, is characterized by intestinal obstruction, consists of a twisting of the small intestine, the sigmoid flexure of the colon, or, much more rarely, the transverse colon upon its mesentery, thus at once obstructing the passage and destroying the circulation. The twisting of the mesentery gives rise to severe pain.

The closure of the intestine causes nausea and vomiting, the vomitus consisting at first of stomach contents, then mucus and bile, and later more or less decomposed intestinal contents.

The vomiting appears early when the volvulus occurs in the jejunum, later when in the ileum, and quite late when in the colon.

The condition is frequently preceded by a slight fall or by excessive lifting or straining. Occasionally it may be mistaken for an acute gastric disturbance, because of taking some indigestible food, and a few times we have observed patients who imagined that they had taken spoiled food and that they were suffering from ptomain poisoning.

Four times we have had patients sent to the hospital with a diagnosis of volvulus in whom we found the obstruction due to a small hernia which had not previously been recognized. The fact that the condition had come on suddenly after a slight exertion had given rise to the mistaken diagnosis. In a fifth case the hernia was so slight that it was not discovered until it was located after the abdomen had been opened, when a small portion of one side of the small intestine was found caught in the femoral ring, the obstruction being due to the kinking of the intestine.

Although it is not always possible to make a differential diagnosis between volvulus and acute intestinal obstruction from other causes it is possible in these cases to determine the presence of a mechanical obstruction to the intestines and it does not matter what may be the cause of this condition as the indication for treatment is always the same.

ACUTE MECHANICAL OBSTRUCTION OF THE INTESTINE.

Before speaking of the special treatment for volvulus it may be well to discuss the treatment of acute intestinal obstruction, which applies to this condition without regard to the mechanical condition which gives rise to obstruction in any given case.

A statement which should be repeated many times and always regarded when any form of intestinal obstruction is considered, and even when there is the slightest suspicion of the possibility of the existence of intestinal obstruction in any given case, is that it is absolutely unpardonable to give either cathartics or any form of nourishment by mouth. In our experience the mortality has been ten times higher in patients who had been given cathartics before coming into the hospital suffering from intestinal obstruction, than in those who had received none.

It is so absolutely clear that if no food be administered by mouth any case in which there is no mechanical obstruction of the bowels does not

need a cathartic because the bowels will move spontaneously if given time and proctoclysis by the continuous drop method, while if mechanical obstruction is present the giving of cathartics will almost certainly kill the patient. In other words in order to prove that a certain number of patients do not have a mechanical obstruction of the intestines one takes the risk, by using cathartics, of destroying the lives of almost all of those who are actually suffering from this condition.

The reason why it is so dangerous to give cathartics in these cases is because they enormously increase the pressure above the point of obstruction, and consequently the intestine is made more permeable to micro-organisms in its lumen and the increased pressure hastens the occurrence of gangrene of the intestine at the point of obstruction.

As harmful as is the giving of food and cathartics in these cases, so beneficial is the opposite form of treatment by means of repeated gastric lavage, which removes a great amount of poisonous material from the alimentary canal and permits the intestines and the stomach to contract. It also prevents the occurrence of inspiration pneumonia caused by the presence of fetid intestinal contents during the operation.

When in doubt in these cases a competent surgeon should operate, although by carefully taking the history and examining these patients an experienced surgeon can almost always make a positive diagnosis.

On the other hand an inexperienced surgeon who is in doubt should continue denying absolutely everything by mouth, should employ gastric lavage and administer normal salt solution by rectum by the continuous drop method until the patient can be gotten into the hands of a competent surgeon.

Operative Technique.

When it is possible to locate the twisted loop of intestine by the bulging of some portion of the abdominal wall, or by auscultation (the intestinal fluid moving up to a given point and stopping at such point), or by the accurate location of pain or tenderness, it is well to make the incision either in the median line or by splitting either rectus abdominis muscle longitudinally directly over the affected part.

Should the location or the character of the obstruction, or both, not be positively demonstrated before the abdomen is opened it is best to make a median incision if the appendix, the gall bladder or the duodenum are probably not the seat of the trouble; otherwise an incision splitting the right rectus abdominis muscle probably gives the best approach to the diseased part because the location of this condition is twice as frequent in the right as in the left half of the abdominal cavity.

If the intestines are greatly dilated and the patient is in a fair condition the gas and feces should be first evacuated by emptying a small portion of the most prominent loop of the intestine by squeezing the contents in either direction, then having an assistant hold this empty portion between the finger and thumb of each hand, thus preventing its refilling. A circular silk suture is then applied at a point farthest away from the mesenteric attachment of the intestine, then a longitudinal slit is made into the lumen of the intestine two cm. long. A glass tube two cm. in diameter, with smooth ends, and sixty cm. long is inserted into this opening and the edges of the wound are inverted and the suture is tied in a loop so that it can be untied later on. Then the assistant relinquishes his grasp upon the intestine and its contents are permitted to pass out through the glass tube. It is usually impossible to

push this tube into the intestines, as demonstrated experimentally by Monks, but the intestine can be threaded upon the tube successively until all of the gas and feces have escaped. The intestine is filled and emptied several times with normal salt solution at 100 to 105 degrees F. Then the tube is withdrawn slowly and this portion of the intestine is again grasped by the assistant in order to prevent its refilling and the glass tube is threaded into the opposite end, which is emptied and washed in the same manner. Then the tube is withdrawn and the wound in the intestinal wall closed, an assistant compressing the bowel at either side to prevent leakage. It is remarkable how quickly the intestine takes on a normal appearance under this treatment, and how well these patients bear the operation.

After the above procedures it is possible to locate the volvulus, because this will be the only portion of the intestine that remains distended. If the intestine is gangrenous or if the mesenteric vessels are thrombosed its excision according to the methods already described is indicated. If the volvulus has not so resulted then the intestine must be untwisted and if there are any adhesions they must be clamped, cut and ligated. If the intestine contained in the volvulus is of considerable length and not gangrenous it is well to leave the glass tube in place and to evacuate the gas and fluid contained in this loop before the intestine is closed. If the volvulus includes the sigmoid flexure or the descending colon it is well to pass a rubber tube up through the rectum and just beyond the loop involved in order to secure drainage and to keep the loop in position until it has been restored from the effects of the torsion. The tube should be composed of fairly pliable rubber to prevent injury from pressure. It is well to have the tube split longitudinally to facilitate its acting as a drain.

Should the patient's condition be very bad it may be best simply to make an enterostomy by bringing up a distended loop, attaching it to the parietal peritoneum, then finding the volvulus, untwisting it, and leaving it in place. This operation in volvulus is so seldom followed by recovery that in almost every case the method described before is preferable.

ACUTE INTESTINAL OBSTRUCTION DUE TO CONSTRICTING BANDS OF ADHESIONS.

Here there is usually a history of a previous operation or of peritonitis from any cause. In all other details the history and the clinical symptoms are the same as in volvulus.

The treatment is the same, with the exception that the location of the constricting band is usually in the vicinity of the former operation, or the former peritonitis the origin of which is more commonly the appendix or the Fallopian tube, than from any other points in the abdominal cavity, although we have seen three cases in which the band represented a remnant of the omphalomesenteric duct.

ACUTE OBSTRUCTION DUE TO KINKING OF INTESTINES.

This condition can but rarely be differentiated before the operation from that just described as its origin and entire history are the same, and the treatment is identical. The attacks are usually somewhat less acute and less violent and the obstruction is frequently not quite complete.

HERNIA.

General Considerations.

The most common anatomical varieties of hernia, in order of their frequency are: 1. Inguinal. 2. Umbilical. 3. Femoral. 4. Ventral. 5. Hernia of the linea alba.

Among the rarer forms are: Ischiatic, Pelvic, Obturator, Lumbar, Diaphragmatic, and the various forms of retro-peritoneal hernia, as retro-cecal, duodenal, hernia through the foramen of Winslow.

Clinically hernias are classified as reducible, irreducible, inflamed and strangulated.

Reducible hernia is by far the most common of all varieties. In this form the hernial contents may be returned into the abdominal cavity spontaneously or when the patient assumes the recumbent position, or by manipulation by the patient or by the physician.

In the early stages of development practically all hernias are reducible. Later on, from the constant irritation, in a considerable proportion of cases, the hernial contents become adherent to the sac making it impossible to effect a complete reduction. This is especially apt to happen in cases of umbilical hernia.

In other instances the hernial sac is large and the neck of the sac is comparatively small, so that considerable effort is required to accomplish the reduction. In many cases in which it seems almost impossible to replace the hernial contents when the patient is in the ordinary recumbent position, reduction may be accomplished with ease after placing the patient in the Trendelenburg position.

The Hernial Sac.

With the exception of some of the rarer forms of hernia, such as diaphragmatic and the retroperitoneal forms, there is one feature common to all, and that is the sac. This sac is composed of a layer of peritoneum which covers either a portion or the entire contents of the hernia. The sac is originally a very thin membrane, but may undergo marked changes in cases of long standing and in those in which an ill-fitting truss has been worn for a long time. In such the sac may become markedly thickened, very tough and of leathery consistence.

In the congenital form, the hernial sac is a preformed pouch of peritoneum which remains empty until some unusual effort or accident causes an increased intra-abdominal pressure, which forces some of the abdominal contents into this pouch.

In the acquired variety the parietal peritoneum is forced by intra-abdominal pressure through some congenital defect in the abdominal wall.

In oblique inguinal hernia the sac always bears a certain relation to the spermatic cord. It is always found in a position anterior to the cord and the spermatic vessels, and is surrounded, together with the latter, by the thin layer of infundibuliform fascia. In inguinal hernia in the female the sac bears the same relation to the round ligament as to the cord in the male and is very closely attached to it.

There are some conditions in which the hernial sac may be incomplete, such as sliding hernia of the sigmoid, cecum and occasionally of the bladder. In such cases the anterior portion of the sac is formed of peritoneum and the posterior portion is continuous with the wall of the sigmoid, cecum or bladder, whichever one may be involved. Clinically it is important to bear

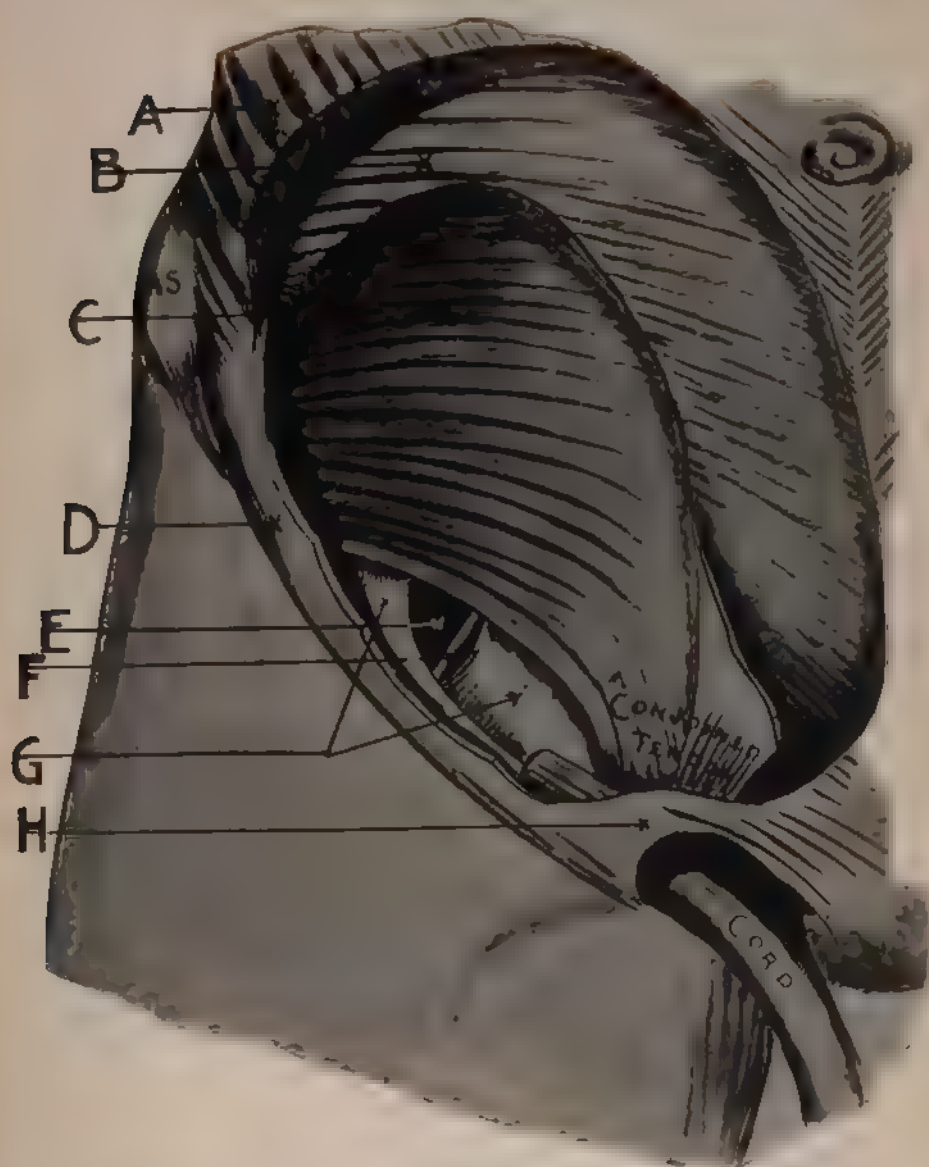


PLATE XLII.

A. External Oblique. B Internal Oblique C Transversalis. D Poupart's Ligament. E Internal Abdominal Ring F Epigastric Artery G Transversalis Fascia. H Below this point is the External Abdominal Ring.

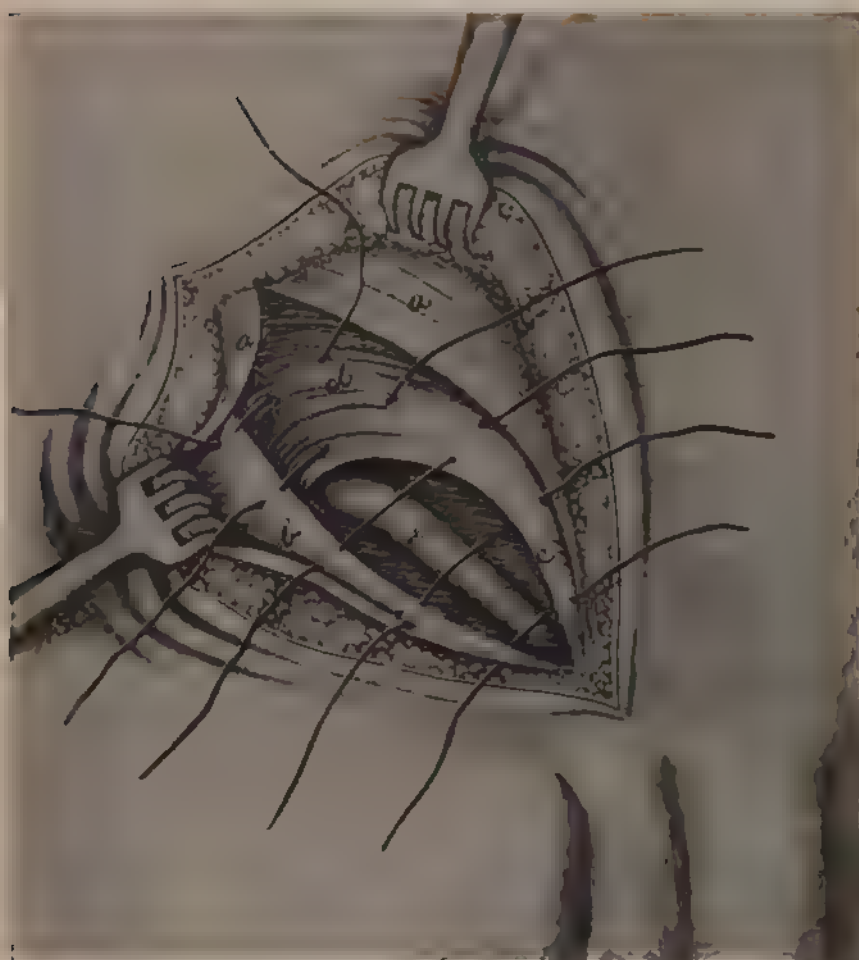


PLATE XI.III.
FERGUSON'S HERNIOTOMY.

Deep chromicized catgut sutures in place. *a* fascia of external oblique abdominal muscle, *b* Poupart's ligament, *c* conjoint tendon, *d* internal oblique abdominal muscle, *e* spermatic cord left undisturbed in bottom of wound.



this condition in mind, in order not to injure the intestinal wall on attempting to open the hernial sac.

In direct inguinal hernia in the male the hernia descends below the epigastric vessels and out through the external ring. It pushes the cord directly in front of it, or to one side, but does not bear such a definite and intimate relation to the cord as is found in oblique inguinal hernia. The sac is not so liable to descend into the scrotum as in oblique inguinal hernia, but is more likely to take an outward direction.

The size and shape of the sac in inguinal hernias vary greatly. In scrotal hernia the sac is most often pear-shaped.

It is not uncommon to find a constriction at about the center, forming an hour-glass shaped sac. The sac is also frequently sacculated, and occasionally to such an extent that a complete double sac is formed.

The contents of the hernial sac also varies greatly. Nearly every organ in the abdominal cavity has been found to form a part or the whole of the contents of the sac. The most frequent contents are the omentum and small intestine, and then some portion of the large intestine, and next the bladder. In femoral hernia the intestine rarely forms any portion of the contents except in cases of strangulation. Various portions of the small intestine may be caught in the hernial sac, but the portion most frequently involved is a loop a short distance above the ileo-cecal valve, which has a longer mesentery than the other portions of the small intestine.

The edge of the bladder is quite frequently found in the sac in inguinal hernias and occasionally a diverticulum or pouch of the bladder forms a considerable part of the sac and also of its contents. This is most frequent in patients who are rather obese and in whom there is a diffuse bulging over the inguinal canal, instead of having a pear-shaped sac descending into the scrotum.

The appendix has been found many times in the sac of inguinal hernia, and R. E. Webster has reported a case of strangulated left inguinal hernia in which a Meckel's diverticulum constituted the contents of the sac.

The ovary and tube together, or the ovary and tube separate, have frequently been found both in femoral and inguinal hernias, and a hernial sac containing the uterus has been reported a few times.

Etiology.

Oblique inguinal, umbilical and femoral hernia occur at points which are naturally weak because of the normal opening through the abdominal wall during fetal life. In many cases of oblique inguinal, and in some of the umbilical variety, these openings have never been closed, so that the hernia is in consequence congenital.

The theory that oblique inguinal hernia is primarily always due to an incomplete closure of the processus vaginalis testis is being accepted by many surgeons. This is due largely to the teachings of Mr. Hamilton Russell, of Melbourne, concerning the "saccular" theory for the etiology of hernia. In accepting this theory, it does not mean that every individual with an incompletely obliterated process must develop a hernia, but the occurrence depends secondarily upon the various conditions usually enumerated as the exciting and predisposing causes of hernia.

Frequently the tissues around the hernial opening are much weaker than normal, so that they will give way much more easily. This is true especially in patients who have one or both parents with a similar defect. (More

than one-third of all patients suffering from hernia give a history of hereditary tendency in this direction.)

The fact that the spermatic cord passes through the inguinal canal makes this form of hernia most frequent. A long omentum with its ability to become insinuated in any opening, however small it may be, is a common predisposing cause in the formation of hernia. The same is true of a long mesentery.

The presence of a great quantity of fat in the abdominal wall markedly weakens this structure, first, from the fact that lobes of fat will invade the natural openings and separate the connective tissue and muscular layers whose function it is to prevent the formation of hernia; secondly, because with the accumulation of great quantities of fat in the connective tissue spaces of the abdominal wall the muscles themselves become softened on account of a certain amount of fatty degeneration which takes place in these tissues. Moreover, at the same time there is always a corresponding increase in the amount of fat within the abdominal cavity, which not only favors the formation of hernia because of its weight, but also because it increases the intra-abdominal pressure.

Exciting Causes.

The chief exciting cause is increased or abnormal intra-abdominal pressure. This may be very violent and of only short duration, as in lifting heavy weights, falling a great distance or with very great force, violent coughing or sneezing, etc. In such case the tissues are virtually torn, making an opening through which the hernial contents protrude. Again, the abnormal intra-abdominal pressure may be less violent and more continuous, as where there is a long-continued cough, chronic constipation, or an obstruction of the urethra on account of phimosis, stricture, enlargement of the prostate gland or stone in the bladder. The same is true of gaseous distension of the stomach and intestines due to digestive disturbances. Adhesions following peritonitis due to appendicitis, or infection through the Fallopian tubes, is likely to have the same effect. In short, anything which may cause abnormal intra-abdominal pressure, either acute or chronic, is likely to bring about the formation of a hernia, especially if there is a predisposition thereto.

General Treatment.

In many of these cases a properly-fitting truss will secure for the patient a relative degree of comfort and safety, but necessitates the wearing of an apparatus which is at best unpleasant and, in summer especially, annoying, uncomfortable, fatiguing and sometimes painful. Aside from this the patient is constantly exposed to the risk of having strangulation, which is, under all circumstances, very dangerous, and quite a considerable proportion of all persons suffering from hernia lose their lives sooner or later as a result of this sequel. Many persons suffering from hernia find it difficult to compete with others of their rank and qualifications because of this handicap.

Pre-operative Management.

In a general way the preparatory treatment is the same for these patients as for those about to undergo any other serious operation, with the addition, it may be, of certain steps which are intended to eliminate as much as possible some of the predisposing causes.

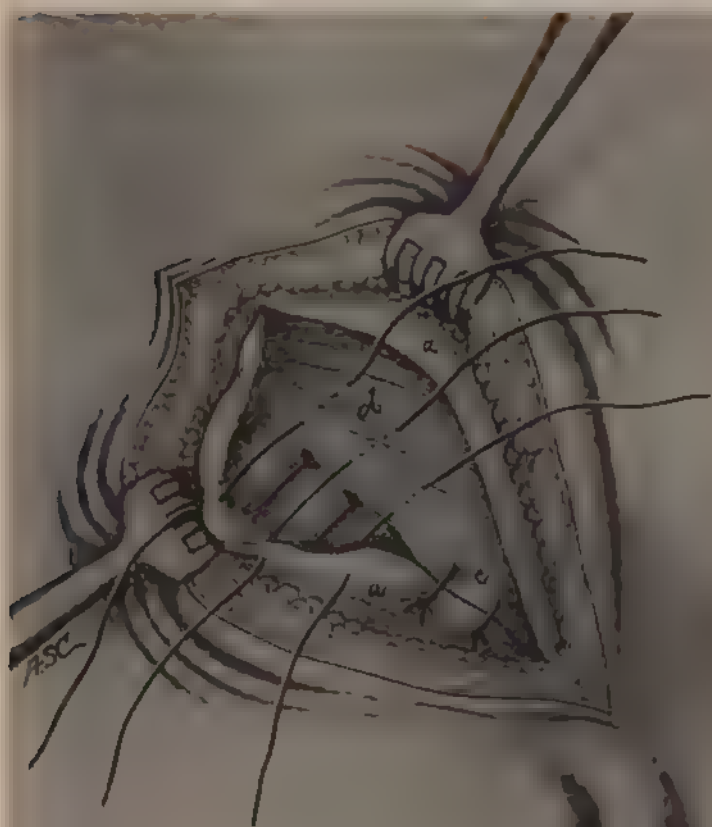
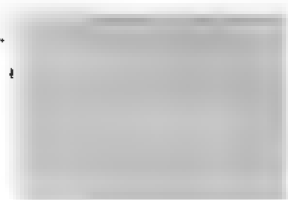


PLATE XLIV

FERGUSON'S OPERATION FOR INGUINAL HERNIA

With deep sutures tied uniting internal oblique abdominal and inguinal muscle and conjoint tendon *b* Poupart's ligament *a* fascia of ilio-lumbar muscle *c* conjoint tendon *d* internal oblique abdominal muscle. The untied sutures show the method of overlapping,—Andrews' principle as applied to Fergusson's operation.



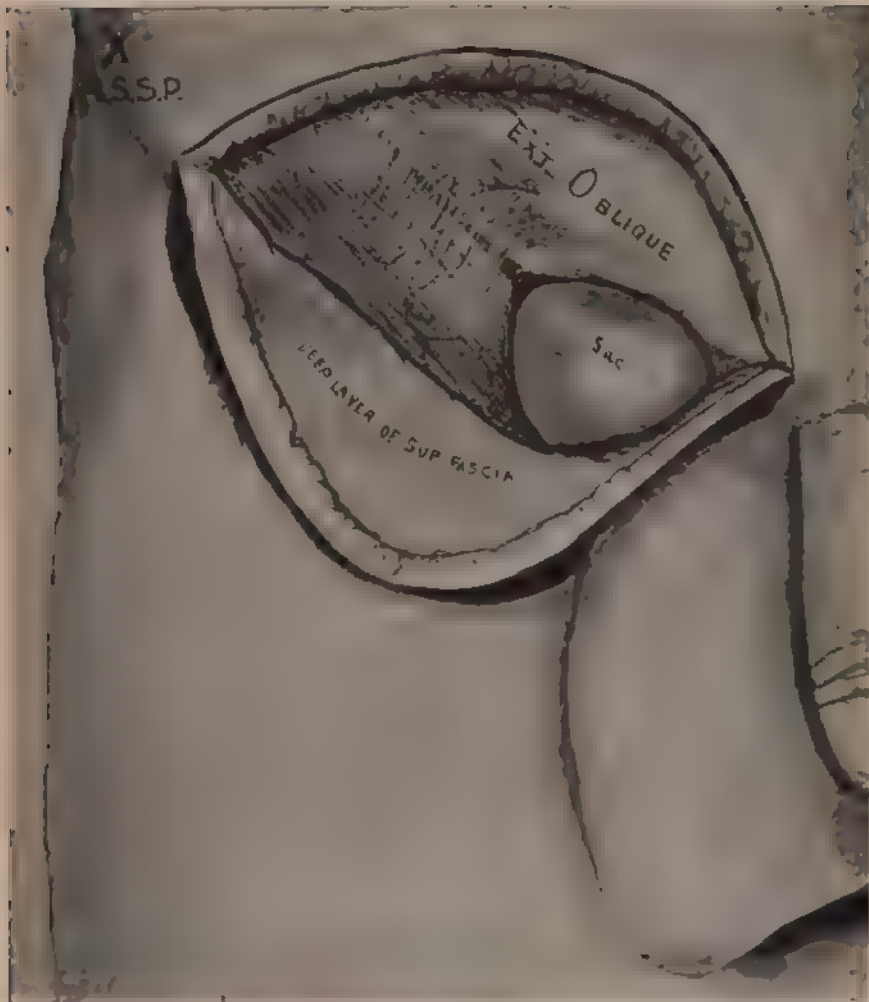


PLATE XLV

INGUINAL HERNIA

Shows the anatomical structures exposed by the primary incision. The hernial sac bulges through the external abdominal ring and hides the tissues of the spermatic cord. The fascia of the external oblique abdominal muscle shows a point of weakness directly over the inguinal canal quite common in inguinal hernia.

Taken from Professor A. H. Ferguson's original drawings, with his kind permission.

It is well, for instance, to place patients who have a great accumulation of fat in the abdominal wall upon a systematic course of treatment for the reduction of this fat, if possible, before the operation is performed. We have usually employed the following diet with excellent results, the patient losing from three to ten pounds per week; the general appearance and strength improving constantly during this treatment. Many have lost a total of from thirty to sixty pounds in weight, and in a few very obese patients the loss has exceeded one hundred pounds.

The diet may be varied to suit the individual case.

DIET LIST.

Breakfast.—

Tea— $4\frac{1}{2}$ oz.—A very small cup.
Milk— $\frac{2}{3}$ oz.—One and a half tablespoons.
Sugar—75 grs.—A small lump.
Bread—375 grs.—A very small slice.

Dinner.—

Sour wine— $3\frac{1}{3}$ oz.—A wineglassful.
One egg, or lean meat—10 oz.
Lettuce with vinegar— $1\frac{2}{3}$ oz.
Vegetables— $1\frac{2}{3}$ oz.
Bread—375 grs.

Supper.—

Wine— $\frac{1}{2}$ pint.
Water— $\frac{1}{2}$ pint.
Quarter small chicken, or 8 oz. lean meat.
One egg.
Bread—375 grs.

These meals may be changed about to suit the inclination of the patient. It is quite as well to take the food prescribed for lunch at breakfast time, and *vice versa*. Men who are in business frequently find the breakfast insufficient, and the bread may then be omitted and 8 to 12 ounces of lean steak substituted.

Drink nothing during the meal, nor for an hour before or after, except as given in the above list. When thirsty during the day drink a little sour wine or sour lemonade.

Aside from this the patient is advised to walk systematically, beginning with that which is perfectly comfortable on the first day and increasing it one-fourth mile daily until the distance reaches from six to twelve miles. At first the habitual speed of walking should be practised, but this should be increased until the patient covers the entire distance at a maximum speed for his strength. During this walk he should breathe very deeply through the nose, the lips remaining closed.

Other hygienic measures like hot baths followed by cold shower, massage and various gymnastic exercises may be added to this plan.

All this will not only reduce the amount of fat in the abdominal wall, but also to a great extent in the omentum and mesentery and underneath the peritoneum, thus reducing the intra-abdominal pressure to a marked degree, and at the same time increasing the firmness of all the tissues in the vicinity of the hernia.

If there is an abnormal amount of intra-abdominal pressure due to

gaseous distension of the abdomen caused by indigestion this should be corrected. The same is true of constipation, or obstruction to the passage of urine, or a chronic bronchitis. In short, so far as possible, it is wise to eliminate the predisposing causes of hernia before the operation for radical cure is undertaken.

The same rules should be borne in mind in the after-treatment. Provision should be made against the recurrence of these predisposing causes after the patient has once been relieved of his hernia by an operation.

INGUINAL HERNIA.

Typical Case.

Our patient is thirty-eight years of age and a farm laborer by occupation. One sister died at eighteen and one brother at twenty years of age. His mother suffered from a rupture. Patient had whooping cough in childhood and typhoid fever at eighteen; was weakly and ill most of the time until the age of twenty. He had pneumonia at the age of thirty-three. At the age of thirty patient felt some pain in both inguinal regions, after climbing a tall tree. One week later he jumped suddenly out of bed, when he experienced a pain in the left inguinal region. At this time he noticed a small bulging over the left inguinal canal. He wore a truss for three years, when he was apparently cured. At this time he suffered from pneumonia, coughed a great deal, and when he had recovered from this sickness found that the hernia had returned. He again wore a truss, which retained the hernia, but the hernial opening showed no further tendency toward closing.

Three weeks ago, after patient had been working hard in the field, he noticed a slight bulging on the right side, which has increased constantly until it has now attained the size of a hen's egg. Neither hernia has caused pain. There has been no tendency towards strangulation. When the patient is in a recumbent position the herniæ always reduce spontaneously.

The patient is fairly well nourished. Lungs, heart, kidneys and abdominal organs are normal; the tongue is slightly coated; appetite good; bowels regular.

The abdomen is normal except for a marked weakening over both internal abdominal rings, causing a bulging the size of a hen's egg over each inguinal canal when the patient is in the erect position, and this is still further exaggerated upon coughing. The enlargement is a little more marked upon the right side. Patient complains of a feeling of weakness at this point in the abdominal wall and he is compelled to support it with his hand when he attempts to lift any weight. The right inguinal canal easily admits the tips of two fingers; the left the tip of one finger only.

The contents of the canal can be easily reduced into the abdominal cavity by means of a slight amount of pressure, and upon taking the recumbent position the bulging disappears at once.

All of the conditions are so clear that there can be no difficulty in making a diagnosis of uncomplicated double inguinal hernia.

Differential Diagnosis.

It is almost impossible to make a wrong diagnosis in simple cases of reducible inguinal hernia, but it is quite different if some complication exists. The most common of these consist of adhesions. If some of the hernial contents, such as the omentum or intestine, are adherent to the

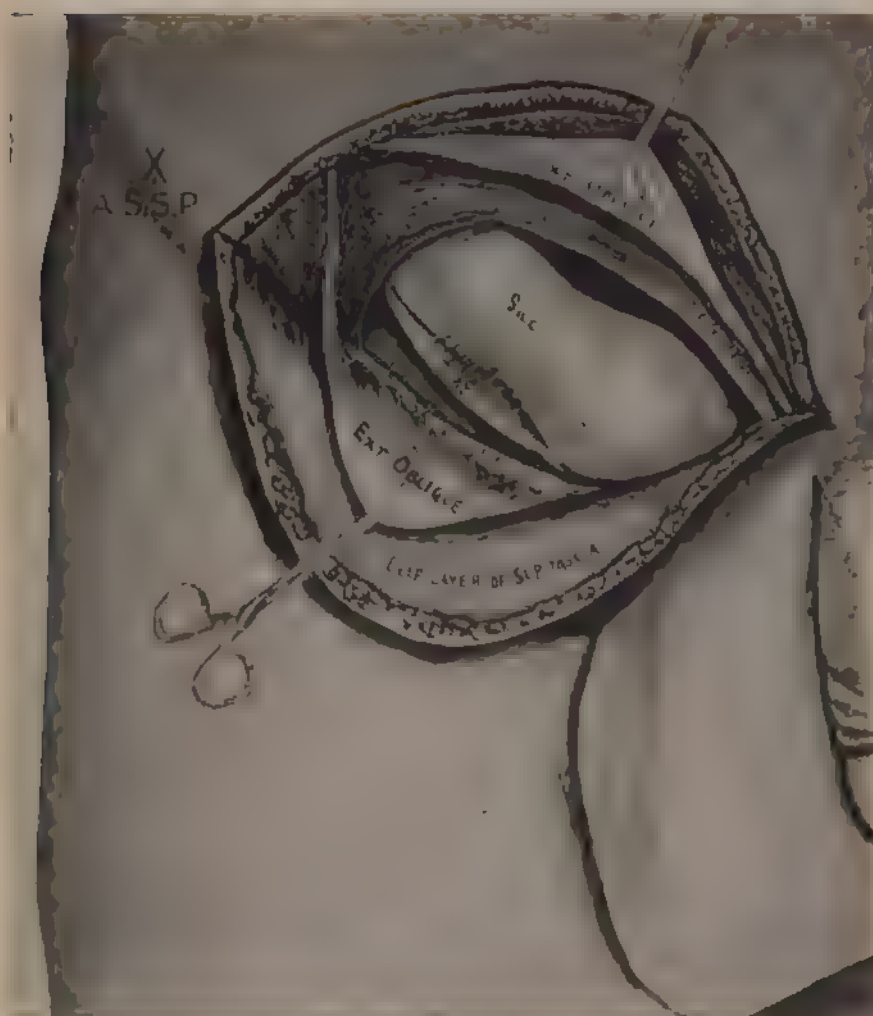


PLATE XLVI

INGUINAL HERNIA

Represents all of the anatomical structures laid bare, the first incision having extended down to the fascia of the external oblique abdominal muscle, the next incision having split the fascia of the external oblique which has been retracted exposing the hernia sac, the spermatic cord, Pampin's ligament, the internal oblique and the conjoint tendon.

Taken from Professor A. H. Ferguson's original drawings, with his kind permission.

hernial sac, or if the hernia is complicated by an acute inflammatory condition, it may be mistaken for an inflammation of the inguinal lymphatic glands.

The latter condition is, however, usually preceded by an infection of the urethra or the prepuce, or of some portion of the lower extremity such as may come from an infected corn or from some slight abrasion of the skin.

If the hernia has extended down into the scrotum it may be difficult to differentiate it from hematocele or a hydrocele, although one can usually see rays of light shining through the latter by placing a small tube against the scrotum and holding a light on the opposite side. Moreover, by grasping the tissues opposite the external abdominal ring between the finger and thumb one can always feel the tissues of the cord above a hydrocele, but not above a hernia, except in children suffering from an irreducible hydrocele of the cord, to be considered later. On the left side a large varicocele is sometimes mistaken for hernia and *vice versa*. This, however, should not occur, because the enlarged veins have a peculiar, wormlike feeling in varicocele which may be easily recognized.

Occasionally an inguinal hernia and a femoral hernia occur in the same patient, and, in a few cases, instead of extending in the direction of the inguinal canal into the scrotum an inguinal hernia will descend to the upper portion of the scrotum and then be deflected outward to a point opposite the femoral ring, and thus have the appearance of a femoral hernia.

In a similar manner a femoral hernia, instead of descending after protruding through the femoral opening, may extend upward and form a swelling in the region of the inguinal canal and thus have the appearance of an inguinal hernia. So long as the hernia is reducible in either case the diagnosis can readily be made, because the opening through which the hernia has protruded can be demonstrated by digital examination; if this is above Poupart's ligament it is an inguinal, if below, a femoral hernia.

Tumors are very rare in the region of the inguinal canal, but we have seen a lipoma and several sarcomata which had been diagnosed as inguinal hernia.

Etiology.

There can be no doubt but that there is an hereditary tendency in many families to the formation of hernia. If both parents in a family suffer from this defect some of the children are almost certain to be afflicted in the same manner. The well-known fact that special defects in families are likely to be inherited is shown in this disease. There is a much larger proportion of herniæ in nationalities in which intermarriage between first cousins is freely practised than in others in which this is forbidden.

The natural opening in the inguinal canal in the male, due to the descent of the testicle, makes the occurrence of inguinal hernia much more common than in the female.

Long continued, exhausting diseases cause a relaxation of the tissues of the abdominal wall, which predisposes to the formation of hernia.

In a considerable proportion of cases the inguinal canal had never been completely closed after the descent of the testicle, and it required only a slight dilatation of the internal abdominal ring, followed by a sudden increase of pressure, to force down some of the intra-abdominal contents, and the hernia is thus established. A long, thin omentum greatly favors this last step.

Indications for Operation.

In our typical patient the hernia can be readily reduced and retained by means of a truss, hence the conditions are very similar to those discussed in connection with femoral hernia. We can undoubtedly relieve this patient of the discomforts of wearing a truss, and the dangers of a possible strangulation, by a safe operation, which will disable him for work not longer than one month. There can consequently be little doubt concerning the wisdom of his choice of treatment.

Preparation for Operation.

The intestinal canal should be thoroughly emptied by the administration of two ounces of castor oil the day before operation, followed by a large soap and water enema that evening and another early on the morning of operation. The field of operation should be shaved the evening before operation and the following morning the patient takes a hot soap and water tub bath. As soon as the patient is anesthetized the skin area is washed thoroughly with soap and water (being careful not to cause irritation), then it is washed with 1-2,000 bichloride solution, then with alcohol. The surface is dried and painted with full strength compound tincture of iodine.

Operative Technique.

An incision ten to fifteen centimeters in length is made in the direction, and over the center, of the inguinal canal, beginning at a point two centimeters above the scrotum. This is carried through the skin, superficial fascia and fat, exposing the fascia of the external oblique abdominal muscle with the hernial sac protruding at the lower end of the inguinal canal, as shown in plate.

The fascia of the external oblique is now slit up in the direction of the inguinal canal to a point five centimeters above the internal abdominal ring. The edges of this are now carefully retracted, and the soft tissues, consisting of fat, portions of the cremasteric muscle and connective tissue, are carefully dissected away, leaving the anatomical structures plainly exposed, as shown in plate. The fat can be removed most perfectly and rapidly by stripping between the layers of a piece of moist gauze held between the fingers and thumb. This exposes the ledge of Poupart's ligament and the fascia of the external oblique below, the internal oblique and transversalis fascia and the fascia of the external oblique above, and between these the hernial sac and the spermatic cord; and to the outer side, the fibers of the internal oblique, as shown in plate.

The hernial sac is now carefully dissected out, caution being taken not to injure the tissues of the spermatic cord, which in this case we find continuous with the upper portion of the sac, showing that we have to deal with a congenital hernia, the tunica vaginalis having remained open since birth, the internal ring, however, being so nearly closed that there was no protrusion of omentum until many years later.

In order to facilitate the separation of the upper portion of the sac we will open the latter. It contains a long, thin portion of omentum. This is drawn down gently as far as it will come without using any force. It is spread out and the vessels are ligated by passing around them catgut ligatures at each point at which they can be seen by holding up the spread omentum to the light. Then the omentum is cut away beyond these liga-



PLATE XLVII.

INGUINAL HERNIA

Represents the fascia of the external oblique retracted, the internal oblique and conjoint tendon sutured to the ledge in Poupart's ligament, the spermatic cord remaining undisturbed in its normal position.

Taken from Professor A. H. Ferguson's original drawings, with his kind permission.

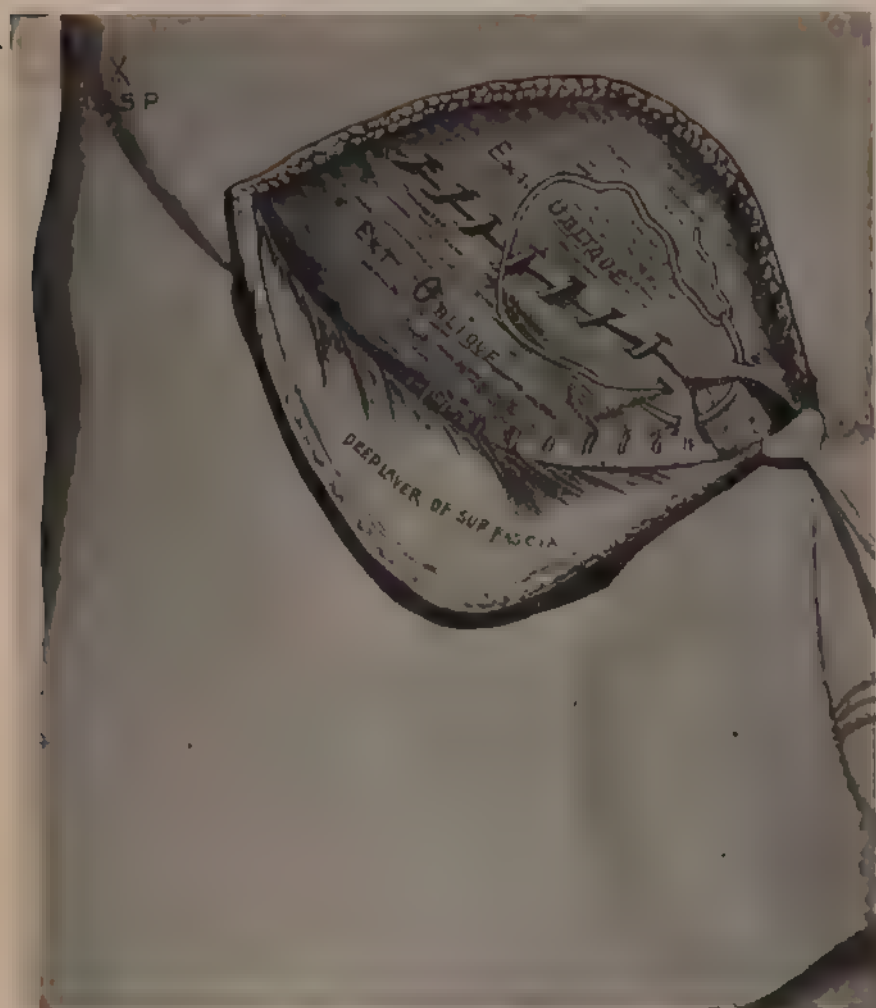


PLATE XLVIII

INGUINAL HERNIA.

This figure shows the sutures attaching the internal oblique and transversalis abdominal muscles to Poupart's ligament, in place and over these tissues the fascia of the external oblique sutured in a separate layer, the spermatic cord issuing at the lower angle. Suturing the skin and superficial fascia over all will complete the operation.

Taken from Professor A. H. Ferguson's original drawings, with his kind permission.

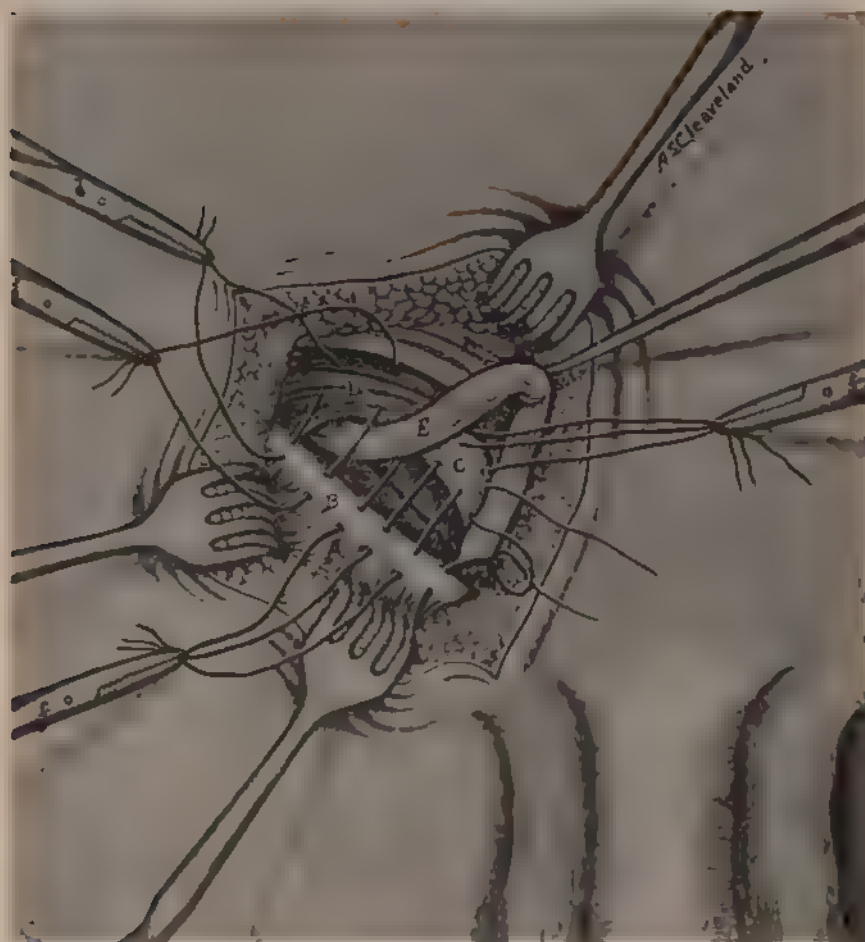


PLATE XLIX

BASSINI'S OPERATION FOR RADICAL CURE OF INGUINAL HERNIA

A fascia of external oblique abdominal muscle, *B* Poupart's ligament, *C* conjoint tendon, *D* internal oblique abdominal muscle, *E* spermatic cord. Chromicized catgut sutures above cord, & the same below cord

tures, preserving enough tissue to prevent slipping. The sac is now dissected up to a point quite within the abdominal cavity; it is then transfixed with a needle carrying a double catgut ligature and tied so as to prevent slipping. The sac is cut away, care being taken to leave enough tissue to prevent the slipping of the ligature. The stump is now retracted within the abdominal cavity by the elasticity of the peritoneum.

The steps which have just been described are exceedingly important, especially the careful removal of the soft tissues, the hernial sac and the omentum, because neglect of any one of these points would tend to cause a recurrence.

The internal oblique muscle and transversalis fascia are now carefully sutured with interrupted sutures of chromicized catgut to the ledge upon the under surface of Poupart's ligament, the edge of the fascia of the external oblique being carefully retracted, as shown in plate.

In applying these sutures, it is well to bear in mind the possibility of injuring the deep epigastric vessels by carelessly grasping the tissues above with the stitch, or the iliac vessels below in the same manner. The simplest way to avoid injuring the latter is to insert the needle through Poupart's ligament from within outward.

The fascia of the external oblique muscle is then sutured as shown in plate. The skin is then sutured over all.

This method, known as Ferguson's operation, has the advantage of closing the inguinal canal perfectly, firmly and permanently, and at the same time leaving the tissues of the spermatic cord undisturbed.

Since the publication of this method by Dr. Ferguson we have used it because it combined all of the good qualities of Bassini's operation, which we had practised with most excellent results for a number of years previously, and has the advantage of being simpler in that it does not disturb the tissues of the spermatic cord.

In order to illustrate the latter method, however, especially as it is the one still in use by most of the best surgeons, we will perform Bassini's operation upon the other side. For the sake of simplicity we can make use of the illustrations just shown of a herniotomy upon the left side, because all the steps, with one exception, are identical.

The incision, the exposure of the anatomical layers, the removal of the soft tissues and the hernial sac are the same. In the last step, however, we find this difference: The sac is not continuous with the tissues of the spermatic cord, but is simply adherent by means of delicate fibers of connective tissue, showing that on this side we have an acquired and not a congenital hernia.

We also find that the sac contains no omentum. It is likely that this descended into one side occasionally and then into the other, or the other side may have contained omentum and this side intestines regularly. Having disposed of the hernial sac as before, we make the step in the operation in which the two methods named differ. The tissues of the spermatic cord are carefully loosened from all of the surrounding tissues. Then we elevate it from the floor of the inguinal canal by means of a blunt hook and insert the stitches of chromicized catgut, as shown in plate. These stitches are applied precisely as before, grasping the same tissues. Two of them being applied above the cord and the others underneath the elevated cord, so that the latter passes out between the second and third stitch, counting from the outer side. Six stitches will usually suffice. They

may be applied with greater regularity if they are not tied until all are in place. The same care must be taken to prevent the injury of the deep epigastric and iliac vessels as before.

The two stitches above the cord are of the greatest importance, because it is at this point that recurrence is likely to take place. After these stitches have been tied the fascia of the external oblique muscle and the skin are sutured as before.

Variations in Technique.

Occasionally the tissues to the inner side of the inguinal canal are so attenuated that it seems difficult to secure a permanent closure of the hernial opening. In this event it may become necessary to utilize the rectus abdominis muscle—Bloodgood's method. The fascia covering the outer edge of the rectus abdominis muscle is split longitudinally and the muscle is then sutured to Poupart's ligament, together with the conjoined tendon of the internal oblique and transversalis.

Prognosis.

Both of these operations, if performed with great care, will result in a permanent cure of inguinal hernia in almost every case, provided that the patient prevents for the future the recurrence of abnormal intra-abdominal pressure.

In the female patient the operation is done precisely in the same manner, with the exception that the round ligament, which corresponds to the tissues of the spermatic cord, is practically disregarded.

FEMORAL HERNIA.

Clinical Case.

An unmarried woman, twenty-eight years of age, a servant by occupation, gives the following history:

Her parents, brothers and sisters are well. She was well and strong as a child; menstruation since the age of sixteen, regular and normal. She has worked hard as a servant since the age of twenty. At twenty-two she first noticed a slight protrusion in the region of the left femoral canal. This has increased gradually. It is now the size of a hen's egg. She can reduce it readily, but suffers from a dragging pain when working hard; in fact, even when she is compelled to stand or walk she is very uncomfortable.

She is well nourished, the various organs are normal, both as regards their anatomical position and physiological functions. Upon standing a swelling develops in the left femoral region to the size of a hen's egg. The swelling disappears instantly upon resuming the recumbent position, and an opening that will admit the tip of a finger can be felt under Poupart's ligament. There is an impulse upon coughing or straining.

The history and physical examination leave no doubt as to the diagnosis. It is an uncomplicated case of femoral hernia.

Differential Diagnosis.

If a portion of the omentum becomes attached to the lining of the hernial sac, on account of inflammatory adhesions, it may occasionally be mistaken for lymphadenitis of the glands normally found in this region.

Lipoma has been mistaken for femoral hernia; the same is true of sarcoma. All of these conditions can, however, be eliminated in this case,



PLATE L.

Typical appearance of femoral hernia

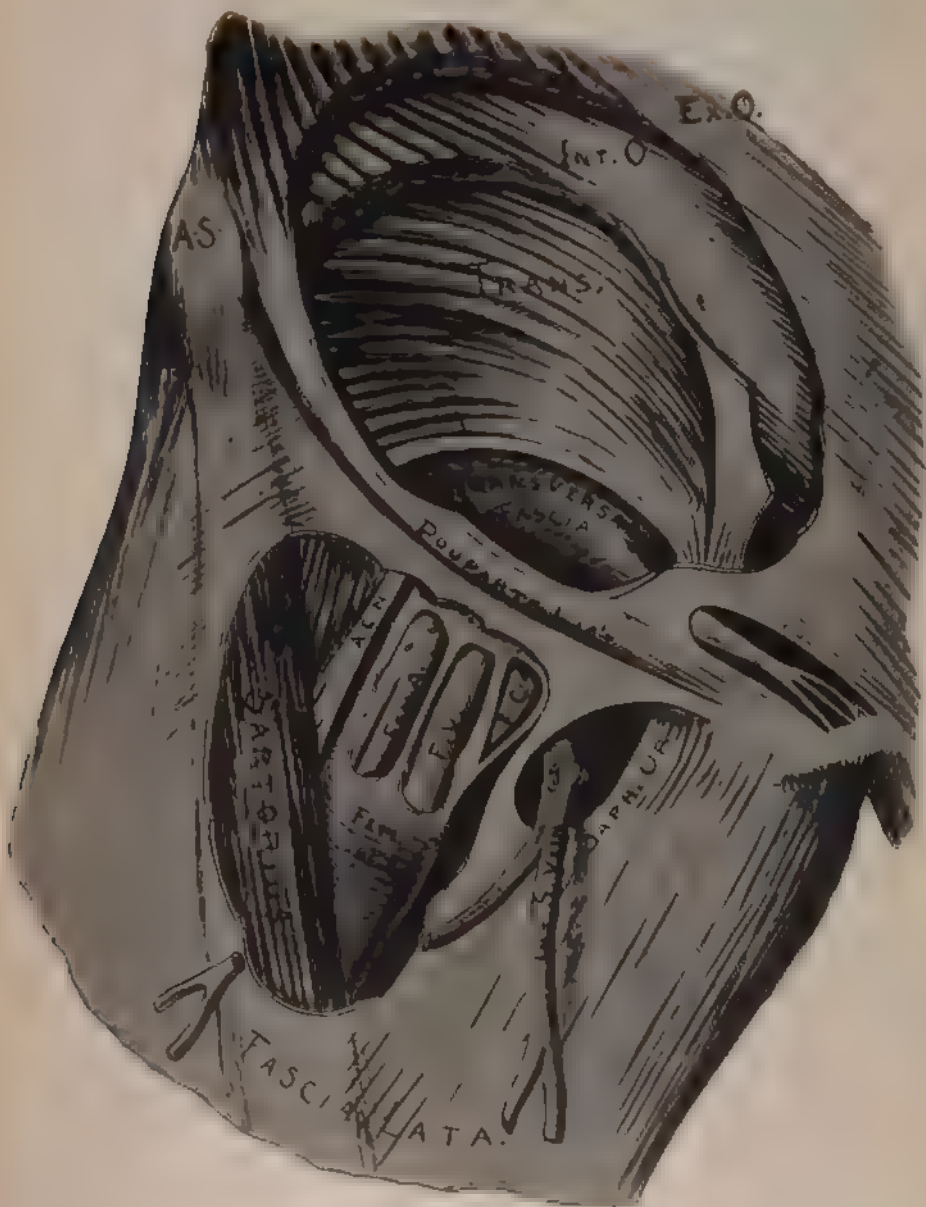


PLATE LI
 Showing anatomy of the femoral region



because there is a definite femoral canal when the swelling is reduced, and there is a distinct impulse upon coughing or straining. Moreover, the condition is too chronic for either sarcoma or lymphadenitis.

The history is interesting from one point alone, which probably explains the origin of this hernia.

Etiology.

So long as this patient remained at home and simply performed her share of the duties in the household of her parents, who were working people with a small income, she remained perfectly well. She went into service as a domestic and was compelled to labor beyond her strength, and consequently soon became relaxed. When she lifted heavy wash boilers, and overexerted herself in other ways, immediately the point of weakness in her femoral region became apparent. The peritoneal protrusion formed a hernial sac and as the omentum or intestine was forced into this sac the latter slowly increased, until it acquired its present size.

Femoral hernia is almost always acquired at a time when the patient is exposed to an abnormal strain, most commonly during the child-bearing period or, as in this case, during a time of hard domestic service.

The treatment may be palliative, by means of a truss which could undoubtedly be adjusted, or curative, by means of an operation.

There are no strong indications in this case. Her suffering is not severe, she is not disabled for work, nor is she in great danger of becoming worse. The only danger is from strangulation, and this is not great, because the opening through which the hernial contents enter the sac seems to be sufficiently large to permit an easy reduction. Should there develop a more marked disproportion between this part and the remaining portion of the sac, strangulation would be more likely to occur. Whatever is done for this patient is consequently not a matter of necessity, but one of choice.

Although a truss would probably retain this hernia, it is not to be chosen lightly, for it will be a hardship for this patient to be subjected to the discomfort of wearing this very uncomfortable instrument for the remainder of her life. Moreover, such a course would be connected with considerable expense. Trusses have to be changed and repaired and are never comfortable to wear.

On the other hand, in choosing an operation for this condition we must be reasonably certain of three things, viz., 1. It must be almost absolutely safe. (This patient is now in good health and is likely to remain so for a long time if no operation be performed, therefore we take a great responsibility in advising an operation if it is not safe.) 2. The result must be permanent. 3. The patient must not be disabled for work for too long a time.

It is believed that all of these conditions may obtain under right management.

The ordinary preparations of the patient in general and of the field of operation are made.

Operative Steps.

An incision is made over the most prominent portion of the swelling, either parallel with the axis of the body or with Poupart's ligament. The center of this incision should be over the middle of the femoral canal.

After the skin and superficial fascia have been severed it is best to

lift the underlying tissues by means of two pairs of dissecting forceps, in order to protect each successive layer of tissue. This will greatly facilitate the operation and at the same time increase the safety to the patient.

It is usually not difficult to recognize the sac on account of its smooth, hard structure, but if the tissues have been severely irritated by pressure from a truss it then is often more difficult. It can, however, always be recognized after it has been opened on account of the smooth peritoneal lining and usually there is an escape of hernial fluid as soon as the sac is incised.

If the sac is recognized before opening it should be carefully separated from the surrounding tissues to a point quite within the femoral ring. It should then be opened to determine its contents. If it contains intestines, these should be replaced into the peritoneal cavity; if omentum, it is well to grasp this with forceps and draw it down until a slight amount of resistance indicates the fact that all of that portion which has occasionally descended in the hernial sac has been drawn down. If the amount is considerable it should be ligated in a sufficient number of portions to prevent its being tied in a mass large enough to cause irritation by its presence in the abdominal cavity.

The ligatures should consist of catgut or fine silk, which should be applied just tightly enough to control the hemorrhage, but not sufficient to crush the tissues. It is well to tie three times if catgut is used, because the peritoneal fluid has a tendency to soften this material and cause the knot to loosen. The portion beyond the ligatures is cut away, care being taken to leave enough tissue to prevent slipping. For the same reason great care must be used in replacing the stump.

It is important to dispose of the long, thin portions of omentum in this manner, because if left undisturbed they are likely to become insinuated in any slight depression which may be left in the abdominal wall at the point of the operation and hence predispose to recurrence.

The hernial sac is then grasped by means of hemostatic forceps and drawn out of the wound as far as possible without tearing it loose, as shown in the accompanying plate. It is then ligated as highly as possible with catgut or fine silk. It is best to transfix the neck of the sac with the ligature mounted upon a needle, and to tie first to one side and then to the other, so as to prevent slipping of the ligature when the pedicle is dropped. A sufficient portion of the sac should be left outside of the ligature to prevent slipping, as shown in the accompanying figure.

When the sac has been cut away the stump will retract within the peritoneal cavity and the ring be left without a lining.

If the cavity formed by the removal of the sac contains masses of fat, these should be removed. This may be accomplished in a moment by grasping these masses with a piece of moist gauze. The fat seems to cling to the rough gauze, while the other structures slip through your grasp. A perfectly clean dissection can be made in this way in a few minutes without harm to blood-vessels and nerves, which would require a considerable time if made with dissecting forceps and scalpel.

This virtually completes the operation with the exception of a row of superficial sutures closing the skin.

If one observes the anatomical conditions present, as shown in the accompanying diagram, it is plain that any attempt at closing the femoral canal after the hernial sac has been removed, must to some extent favor



PLATE LII

FEMORAL HERNIA

Represents a femoral hernia, the entire sac having been dissected free to a point within the femoral ring then transfixed and ligated, the sac being drawn out of the wound with forceps, the scissors being in position to cut away the sac beyond the ligature.



the production of a recurrence, because this canal is almost a perfect ring in most cases.

It is a well-known fact that it is practically impossible to keep any ring in the human body open unless it is lined with mucous membrane, or includes a serous membrane containing fluid; consequently the most certain method of closing this ring consists in removing the serous membrane by removing the hernial sac to a point within the abdominal cavity and permitting the ring to close spontaneously. After applying this plan to a large number of femoral herniæ we are convinced that it is quite as impossible to keep this ring open, unless it is distorted by one of the many methods which have been devised for its closure, as it is to keep any other ring or canal, not lined with serous or mucous membrane, open. In other words, all of the methods which have been devised for closing this ring

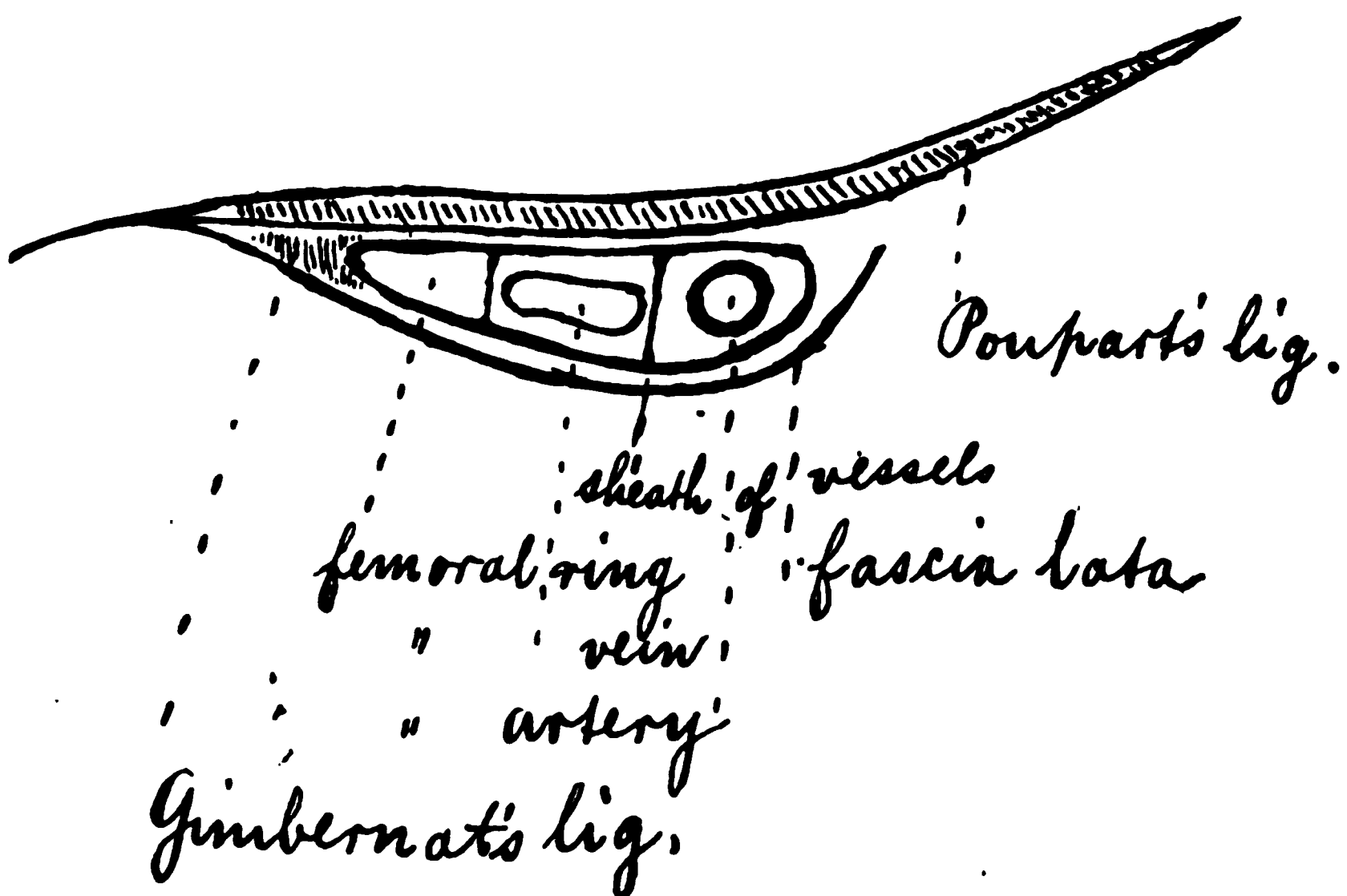


Fig. 17.

are more or less harmful and tend to cause a certain number of recurrences. Of course, if the ring has been injured during the reduction of a strangulated hernia, which could not be accomplished without cutting the ring, then this injury must be repaired in order to restore the original favorable conditions.

In case of femoral hernia due to a severe traumatism, especially a violent blow upon this portion of the body, Poupart's ligament is occasionally separated for some distance from its attachment and then the femoral opening may not be a perfect ring, but a broad gap. In such event it is occasionally wise to freshen the edges of this irregular opening and to construct, as nearly as possible, a perfect ring. There is, however, only a very small proportion of cases in which this is necessary. Indeed, it seems as though the tissues forming the femoral ring were increased in amount to quite a marked extent by the irritation due to the presence of the hernia,

and when once deprived of its serous lining by the removal of the hernial sac this ring contracts and closes with astonishing rapidity.

In most all these patients it is best, if possible, to institute systematic treatment for a month or two before performing the operation, with a view to reducing the obesity.

After-Treatment.

It is important to prevent for a short time the protrusion of the peritoneum into the femoral ring in order to secure for this part the best possible conditions for contracting and closing permanently. This may be favored in two ways: first, by reducing the intra-abdominal pressure, and, second, by keeping the contents of the abdominal cavity from approaching the seat of the operation.

Abnormal intra-abdominal pressure may be continuous as a result of the accumulation of gas in the alimentary canal, or as a result of obesity; or it may be intermittent, as in vomiting or coughing, or if the patient suffers from constipation and has to employ an abnormal amount of intra-abdominal pressure during the evacuation of the bowels. Very rarely there is a form of continuous intra-abdominal pressure affecting herniæ in case of ascites.

The intestines and the omentum may be kept away from the region of operation by elevating the foot of the bed six or eight inches during the first week following the operation, at the end of which time the femoral ring will have contracted sufficiently to prevent any protrusion. This posture, however, is not safe for patients who are advanced in age, because in them it is likely to cause a hypostatic congestion of the lungs, which may result in pneumonia.

The abdominal pressure due to constipation can, of course, be readily relieved, not only for the time immediately following the operation, but the patient should understand the importance of remaining perfectly free from this source of trouble. This will also in a great measure remove another important cause of abnormal intra-abdominal pressure, that due to gaseous distension of the stomach and intestines. This may be overcome readily for the time immediately following the operation by having the alimentary canal thoroughly evacuated on the day before by the free use of a cathartic, preferably by the administration of two ounces of castor oil in the foam of beer or malt, the use of enemata and the prohibition of any form of food which is likely to produce gas.

During the first and second days after operation the patient is given hot water flavored with a little beef extract, if desired, then some prepared, predigested food is given every three hours for a few days, then milk and lime water, then soup, and after ten days or two weeks a light diet is allowed.

Aside from the immediate benefit to the patient there is the further advantage in this plan of feeding that the digestive organs are given an opportunity to rest and recuperate from the results of their abuse, which has usually been long-continued and vigorous.

UMBILICAL HERNIA.

Example.

The patient is forty-nine years of age, a housewife, whose history was of no medical importance until nineteen years ago. At that time,



PLATE LIII

UMBILICAL HERNIA

Represents the hernial ring in an umbilical hernia laid bare, with the tissues dissected back down to the aponeurosis. Two fingers of one hand are inserted into the abdominal cavity in order to protect the intra-abdominal organs against injury from the needle, which is inserted one and one-half to two inches from the edge of the ring. A blunt hook is inserted on either side to stretch the ring transversely.



during an attack of whooping cough, she noticed a slight bulging in the region of the umbilicus. Six months later during the birth of her fourth and last child this condition became considerably worse. It continued to develop slowly until ten years ago, when it was suddenly increased on account of a fall. Patient has suffered from mild melancholia for three years.

Present Condition.

Obese patient; pulse and temperature, heart, lungs and kidneys normal; bowels constipated, tongue coated. Abdominal walls very thick. A protrusion is noticed at the umbilicus, the size of a small fist, covered with very thin skin. The mass cannot be reduced into the peritoneal cavity and is very tender upon pressure. There is also tenderness upon pressure in the right inguinal region.

The condition present in this patient can give rise to but one diagnosis—umbilical hernia.

Etiology.

This hernia was brought about in the usual manner and under the usual conditions. The abdominal wall had suffered from the effects of three pregnancies; it had been weakened by an abnormal amount of fat; then it was taxed beyond its strength by the increased intra-abdominal pressure caused by the whooping cough. To this was added another pregnancy and later a fall. Each of these factors favored the further weakening of the abdominal wall and the increase of the hernial protrusion.

Influence of Age.

In childhood a hernia in this position will heal spontaneously in almost every case, provided the increased intra-abdominal pressure is eliminated, because the opening is a perfect ring composed of tissue which has the tendency to contract. It is quite different in patients over thirty years of age. The increasing obesity primarily overcomes the tendency of the tissues forming the ring to contract; moreover, the abdomen broadens, while the distance between the sternum and the pubis decreases; hence the ring is distorted, which again interferes with its closure.

Still again, the omentum which has been forced into the hernial sac forms inflammatory adhesions and this permanently prevents the closing of the ring.

Remedial Measures.

Were the hernia reducible there might be a choice between palliative measures consisting in the fitting of a truss, and radical measures consisting in an operation for permanent cure. We have consequently the choice between giving this patient an abdominal bandage with a pouch-like arrangement in which to carry her hernia, and performing an operation.

Indications for Operation.

The patient is virtually disabled for performing her household duties, because there is a constant dragging feeling in the region of the umbilicus due to the adhesion of the omentum. For the same reason she is unable to walk, and as a result of this she is compelled to lead a sedentary life, which causes her obesity to increase. There is a kind of vicious circle established. The increase in the hernia prevents her from exercising sufficiently to reduce her obesity and this in turn favors the increase in the

hernia. Unless she is relieved of her hernia she will become more and more helpless.

Preparatory Treatment.

The patient has come to the city from a distance and is compelled, on account of her financial circumstances, to return home as soon as possible. It is also impossible for her to return home and come to the hospital later for the operation. Were it not for these circumstances, it would be much better to first place her under treatment for the reduction of her obesity. The same plan would be followed which has already been described in connection with femoral hernia. This being out of question, we have reduced the intra-abdominal pressure as much as possible by the use of saline cathartics, and placing the patient upon a diet of beef-tea for a few days, also giving hot baths followed by cold showers and massage.

The Mayo Technique.

Of all herniæ this form has been most difficult to treat surgically and has given a larger percentage of recurrences than any other. This has, however, changed since the introduction of Mayo's operation some nine years ago, which has made the results in this form of herniotomy quite as satisfactory as in the inguinal variety.

The operation comprises the following steps:

(1) "Transverse elliptical incisions are made surrounding the umbilicus and hernia; deepened to the base of the hernial protrusion.

(2) The surfaces of the aponeurotic structures are carefully cleared an inch and a half in all directions from the neck of the sac.

(3) The fibrous and peritoneal coverings of the hernia are divided in a circular manner at the neck, exposing its contents. If intestinal viscera are present the adhesions are separated and restitution made. The contained omentum is ligated and removed with the entire sac of the hernia.

(4) With forceps the margins of the ring are grasped and approximated. Whichever way the overlapping is more easy of accomplishment, suggests the direction of the closure. The illustrations show the overlapping as done from above downward.

(5) For this approximation an incision is made through the aponeurotic and peritoneal structures of the ring extending one inch or more transversely to each side, and the peritoneum is separated from the under surface of the upper of the two flaps thus formed.

(6) Beginning from one to one and one-half inches above the margin of the upper flap, three to four chromicized catgut mattress sutures are introduced, the loop firmly grasping the upper margin of the lower flap; sufficient traction is made on these sutures to enable peritoneal approximation with running sutures of catgut. The mattress sutures are then drawn into position, sliding the entire lower flap into the pocket previously formed between the aponeurosis and the peritoneum above.

(7) The free margin of the upper flap is fixed by catgut sutures to the surface of the aponeurosis below, and the superficial incision closed in the usual manner. The lateral approximation is carried out by sliding one side under the other in the same manner. In the larger herniæ the incision through the fibrous covering of the sac may be made somewhat above the base, thereby increasing the amount of tissue to be used in the overlapping process."



PLATE LIV

UMBILICAL HERNIA

Represents three chromicized cat gut stitches in position. The cat-gut is represented double. This is not important, but has the advantage of extra security in case there should be a defect in one strand, besides making it possible to use a smaller size of cat-gut.





PLATE LV

UMBILICAL HERNIA.

Represents the deep stitches tied carrying the lower edge of the wound underneath the upper one, with the stitches inserted which will serve to unite the upper edge of the ring to the aponeurosis of the abdominal wall below.



We have employed chromicized catgut sutures in place of the silver wire sutures in all cases operated by Mayo's method. Having been called upon frequently to remove silver wire sutures which other surgeons had employed in various operations, we have abandoned their use entirely and found that chromicized catgut has all of the good qualities and none of the bad ones of silver wire.

Plate LIII shows the manner in which the stitches are introduced, the fingers protecting the intra-abdominal structures against injury from the needle.

Plate LIV shows the deep stitches in place, which when tied will slide one edge of the ring underneath the other. The line of sutures should extend transversely across the body instead of obliquely, as pictured by the artist. In all of our cases we have found it possible to close the opening without tension by placing the line of sutures in this direction.

In small herniæ three deep, and about five superficial, sutures will suffice, but the number may be increased according to the size of the opening.

Plate LV shows the manner in which the overlapping edge of the hernial opening is sutured to the aponeurosis.

By this method we obtain a double layer of the strong aponeurosis composed of the fascia of the external and internal oblique abdominal muscles, together with the transversalis fascia.

In all of these patients we have observed the fact that they have a sense of security and strength after this operation which none formerly had after operations for the relief of large umbilical hernia by other methods.

Important Points.

Having dissected out the entire hernial sac, together with its overlying thin skin down to the edge of the aponeurosis forming the hernial ring, we must plan to open the sac and dispose of its contents.

There are two areas in which the omentum is usually adherent to the sac, one opposite the most superficial portion, the other along the edge of the hernial ring.

If we attempt to open the sac opposite either of these points we will find an exceedingly tedious and unsatisfactory task. It is quite different if we open the sac on one side half-way between these two points, where the surfaces are usually free from adhesions. It is then best to begin at one point and systematically loosen the adhesions between the omentum and the hernial ring until the former is entirely free. If this is done the entire task can be accomplished in a few minutes, but if one loosens small areas here and there in an unsystematic manner, a great amount of time may be unnecessarily consumed to the detriment of the patient.

Should the sac contain intestines still greater care must be employed for fear of causing a perforation. Should there be an abrasion on the surface of the intestine this should be covered at once with a few Lembert sutures.

Having loosened all of the adhesions between the omentum and the hernial ring, it becomes necessary to dispose of the mass of omentum. The latter is usually so matted together that it would undoubtedly give rise to great discomfort from pressure were it to be returned to the abdominal cavity; it is consequently best to ligate it in a number of portions, to cut

away the part that has been matted together, and return the remaining portion into the abdominal cavity. At this point it is important to observe care not to place the ligatures too near the transverse colon for fear of causing necrosis.

Prognosis.

If this plan of treatment is followed the prognosis in these cases is astonishingly good, both as regards immediate and permanent results.

After Treatment.

It is well to avoid all abnormal intra-abdominal pressure (1) by reducing the obesity by means of diet and vigorous exercise, preferably walking; (2) by avoiding constipation; (3) by regulating the diet so as to avoid gaseous distension; (4) in the male by avoiding obstruction of the urethra, or correcting this should it exist.

Variation of Incision.

Occasionally one will find a small umbilical hernia in a patient to be operated for some other intra-abdominal condition, like tumors of the pelvic organs, appendicitis or gall stones.

If the incision in this operation is to be in the median line it is best to extend it above the umbilicus a distance of one or two inches, to excise the umbilicus entirely, to split the fascia of the recti muscles toward the median line and then to close the abdominal wound throughout as though there had been no hernia.

If the operation is for the removal of the appendix or gall stones it is well to make the incision through the right rectus abdominis muscle, then the inner edge of the abdominal wall can be everted. If there is adherent omentum in the hernial sac this can be peeled out and then a purse-string suture of chromicized catgut passed around the hernial ring with a short curved needle just outside of the abdominal wall and tied just tightly enough to hold the edges in apposition. A second similar stitch is applied just within the abdominal wall and tied in the same manner.

This may be done very easily except in patients with an unusually thick abdominal wall. The method is, however, applicable only to herniae of moderate size.

VENTRAL HERNIA FOLLOWING ABDOMINAL SURGERY.

Type of Case.

The patient, an unmarried woman twenty-two years of age, an office girl by occupation, gives the following history: Uneventful life until age of eighteen, when she had an acute attack of appendicitis, which subsided under treatment but recurred every few months. Two years ago she had an operation for the relief of this condition at the end of an acute attack. The wound suppurated and healed in time by granulation. The patient has been free from acute pain since that time, but has suffered from severe gaseous distension of the abdomen, from digestive disturbances and from constipation. The scar began to broaden soon after the patient returned to her work and shortly afterwards she noticed a distinct bulging of the abdominal wall at the point of the scar. This portion of the abdominal wall has become constantly thinner and the bulging has increased.

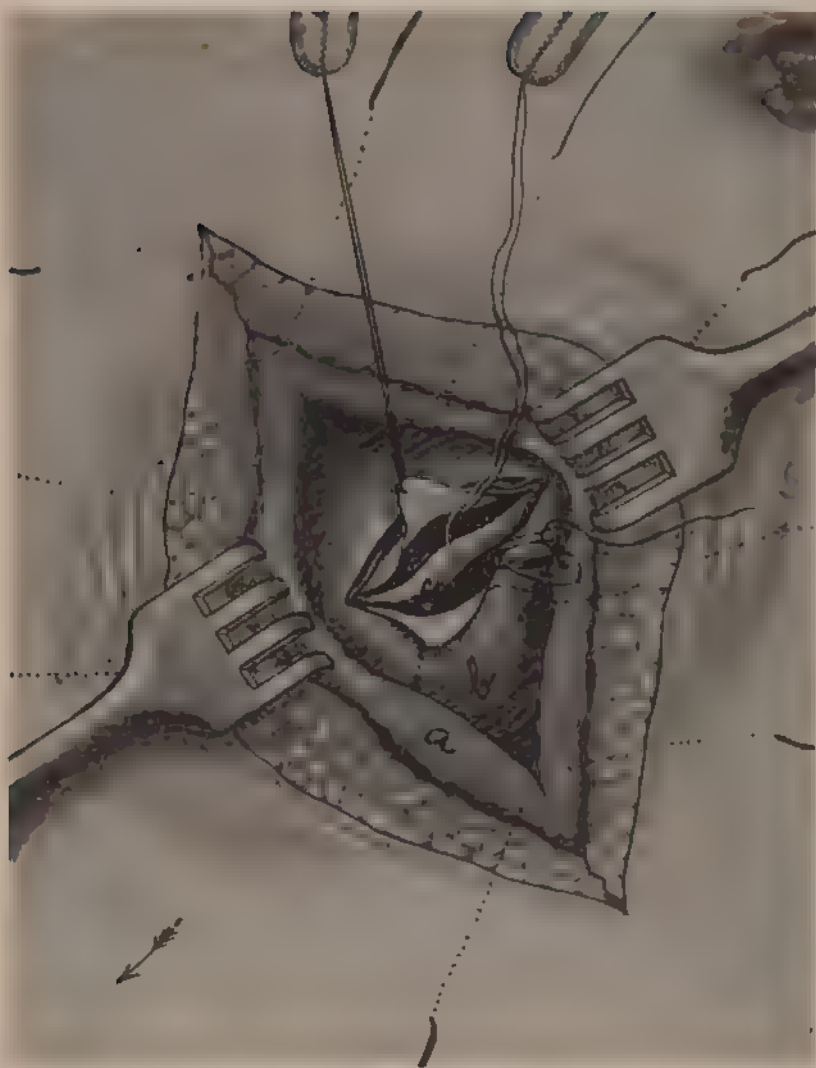


PLATE LVI.

McBURN EY'S INCISION

Represents McBurney's incision, which extends parallel with the fibres of the external oblique abdominal muscle (a) separating its fibres without cutting them then separating the fibres of the internal oblique muscle, (b) again without cutting its fibres and extending through the transversalis fascia and peritoneum (c) in the same direction



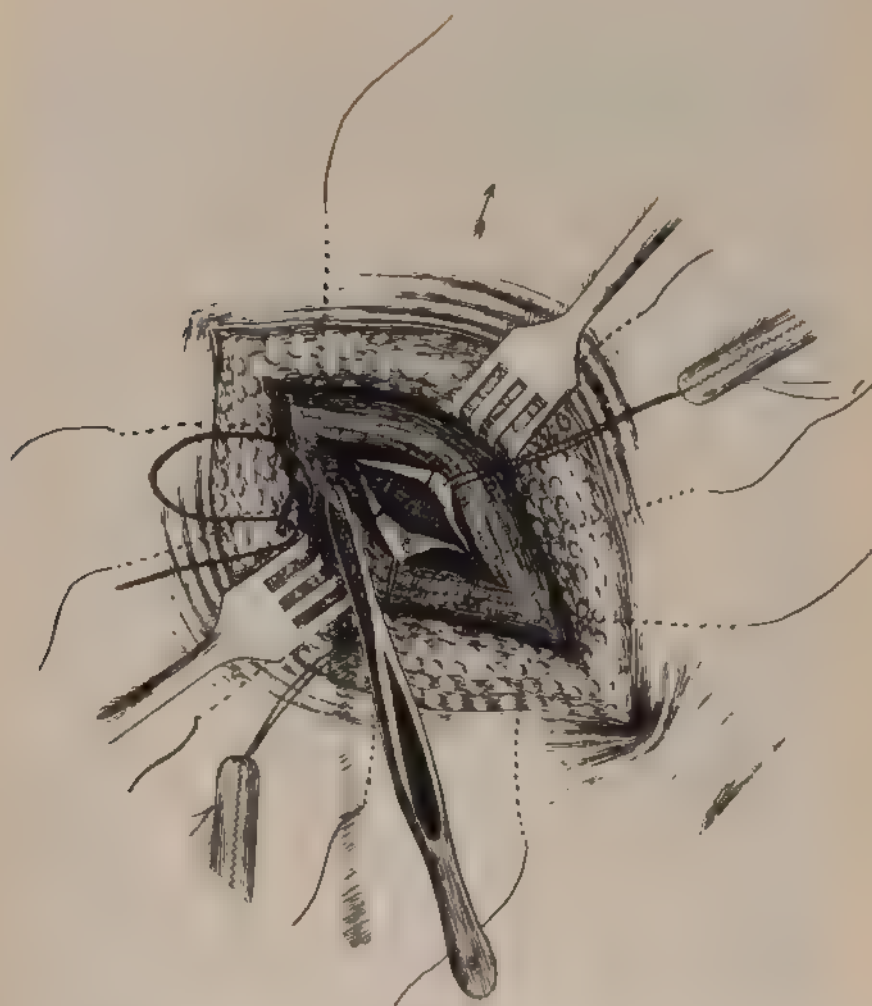


Fig 18

VENTRAL HERNIA FOLLOWING APPENDICITIS OPERATION

Represents an incision through all the tissues of the abdominal wall parallel with Poupart's ligament separating the fibres of the external oblique abdominal muscle, (a), but cutting the fibres of the internal oblique abdominal muscle (b) at right angles and extending through the transversalis fascia and peritoneum (c) in the same direction.

The internal oblique abdominal muscle (b) is by far the thickest layer.





PLATE LVII.

CLOSURE OF ABDOMINAL WOUND.

Represents the manner of applying sutures in closing an abdominal incision in the median line (a) representing the deep strong fascia composed of the aponeurosis of the external oblique abdominal muscles, (b) the rectus abdominis muscle, and (c) the transversalis fascia and peritoneum.



There is a scar ten centimeters in length and five centimeters wide, extending parallel with Poupart's ligament about half-way between the anterior superior spine of the ilium and the umbilicus. The tissue is so thin that the motion of the intestines can readily be distinguished through it. Upon pressing the fingers against this tissue one may readily feel a definite ledge composed of the abdominal muscles on either side, and the intestines can be readily felt behind this thin structure. There is a strong impulse upon coughing. The scar is very tender upon pressure.

Etiology.

In this instance there had been an abdominal section for the removal of the appendix. The incision had been made parallel with the fibers of the external oblique abdominal muscle, then it had been carried through the internal oblique, the transversalis fascia and peritoneum.

All of these layers had been united after the operation, but the suppuration which followed prevented primary union and consequently there was a union between the edges of all the layers involved on each side of the line of incision and the edges thus formed were united by a mass of cicatricial tissue. This is the least stable of all tissues and consequently it began to stretch very soon after the patient left her bed, becoming more and more thinned out from day to day and permitting the intra-abdominal organs to protrude, forming a ventral hernia.

There is another factor in this case which favored the formation of a ventral hernia. The incision was parallel with the fibers of the external oblique abdominal muscle and consequently none of the fibers of this muscle had to be severed, as they were simply split longitudinally. Had the internal oblique abdominal muscle been likewise split, as shown in plate, the two edges would have been drawn closely together as a result of their own contraction, and the lines of incision through the two muscular layers, being at right angles to each other, a hernia would not have developed, even though the wound had not united primarily.

In this case the conditions were quite different, the fibers of the internal oblique abdominal muscle being cut at right angles, the edges of the wound were drawn farther and farther apart with each contraction of this muscle as soon as primary union of the cut ends became impossible on account of suppuration. Moreover, these ends became adherent to the edges of the wound in the external oblique abdominal muscle and overcame the tendency these edges naturally show to remain parallel and in close apposition.

Indications for Operation.

In most cases of ventral hernia following abdominal section there is no definite ring, the opening being wide; there is consequently no danger from strangulation. There is, however, the constant feeling of insecurity and weakness in the abdominal wall which prevents the patient from performing the duties, or indulging in the pastimes, of persons in health, and as the tissues become thinner and thinner, there is really some risk of having them give way entirely.

Moreover, the digestive disturbances of which such patients complain are due partly to the fact that there are usually adhesions between the intestines and omentum and the scar which interfere with the passage of food and gases through the portion of the alimentary canal thus impaired.

When the protrusion is so great as above described, and cannot be comfortably retained by means of a bandage, there is a sufficient amount of mechanical obstruction to the intestines from their crowding into this pouch to account for the digestive disturbances. For these reasons it seems wise to advise operative treatment, especially in young patients.

Operative Technique.

We first make an incision surrounding all of the scar tissue, because this is of no value in securing a permanent cure of the hernia and its removal is of importance from a cosmetic standpoint.

In these herniæ, as in umbilical, the adhesions of omentum or intestine are likely to be to the most prominent portion of the hernial protrusion or to the edge of the hernial ring, which in these cases is so large as scarcely to deserve this name, or to both of these portions.

The operation is greatly facilitated by making the incision through the peritoneum at a point where there are no adhesions. This may usually be accomplished by choosing a location half-way between the two points just mentioned.

A further aid is found in lifting up the tissues with two dissecting forceps, one in the hand of an assistant, the other in the surgeon's hand, and cutting between.

As soon as the peritoneal cavity has been opened, all adhesions are carefully separated in a systematic manner. If abrasion occurs upon the serous surface of an intestine this is at once covered with one or more Lembert stitches. Should the omentum be matted together or appear in irregular bunches or strands these are ligated and cut away. Then the intestines and omentum are replaced into the abdominal cavity and covered with a broad pad of sterilized gauze, moistened with warm normal salt solution.

It now becomes necessary to make a careful dissection of the edges of the wound, in order to lay bare each one of the layers of tissue. This is possible even in cases in which the hernia has existed for a number of years.

We first come to the edges of the incision in the external oblique abdominal muscle and its fascia, then we encounter the fibers of the internal oblique, cut at right angles and greatly retracted, and lastly upon the transversalis fascia and peritoneum combined. All of these layers are shown in Fig. 18. We have found that a hernia in which all the layers have been carefully dissected out in this manner may be closed with the same degree of certainty, as regards permanency of cure, as an ordinary laparotomy wound.

A row of silkworm gut sutures is now inserted, but not tied, as indicated in Fig. 18. The stitches are placed about three-fourths of an inch apart and grasp each layer down to, but not through, the peritoneum. In this case we take especial care to draw the internal oblique abdominal muscle forward, as shown in Fig. 18, with dissecting forceps in order to secure a deep bite. Each layer is then sutured separately with a continuous catgut stitch. For this purpose we prefer to utilize fine chromicized catgut, No. 1, threaded double. This gives the suture the same strength as a heavier catgut used single and has the advantage that it does not twist nor become unthreaded, and, theoretically at least, it offers more favorable conditions for absorption when it has accomplished its purpose.



PLATE LVIII

ABDOMINAL WALL, UPPER THREE-FOURTHS

a skin; *b* fat, *c* external oblique abdominal muscle, *d* internal oblique abdominal muscle; *e* transversalis fascia; *f* peritoneum, *g* linea alba, *h* rectus abdominis muscle. The aponeurosis is divided into an external and an internal layer, the former passing in front, the latter behind the rectus abdominis muscle.



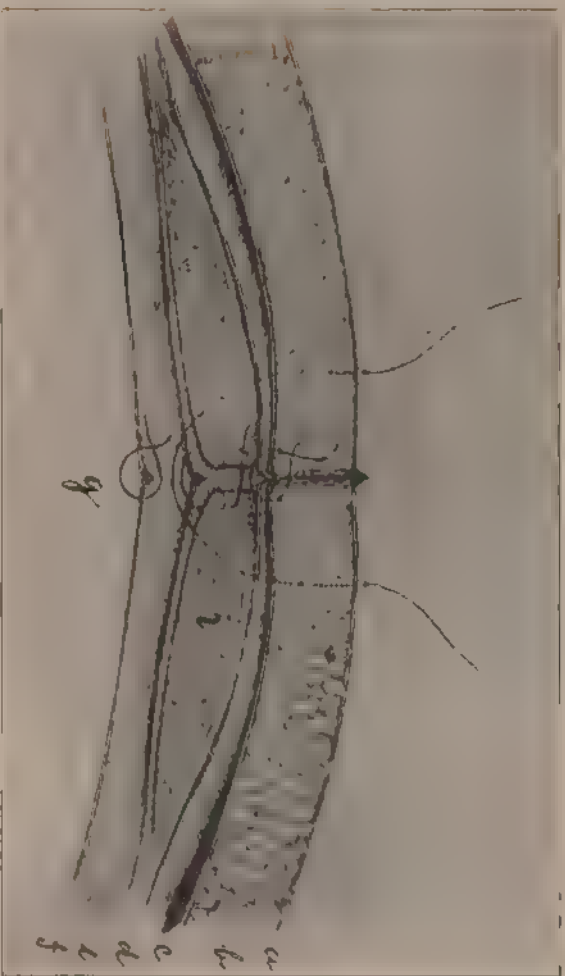
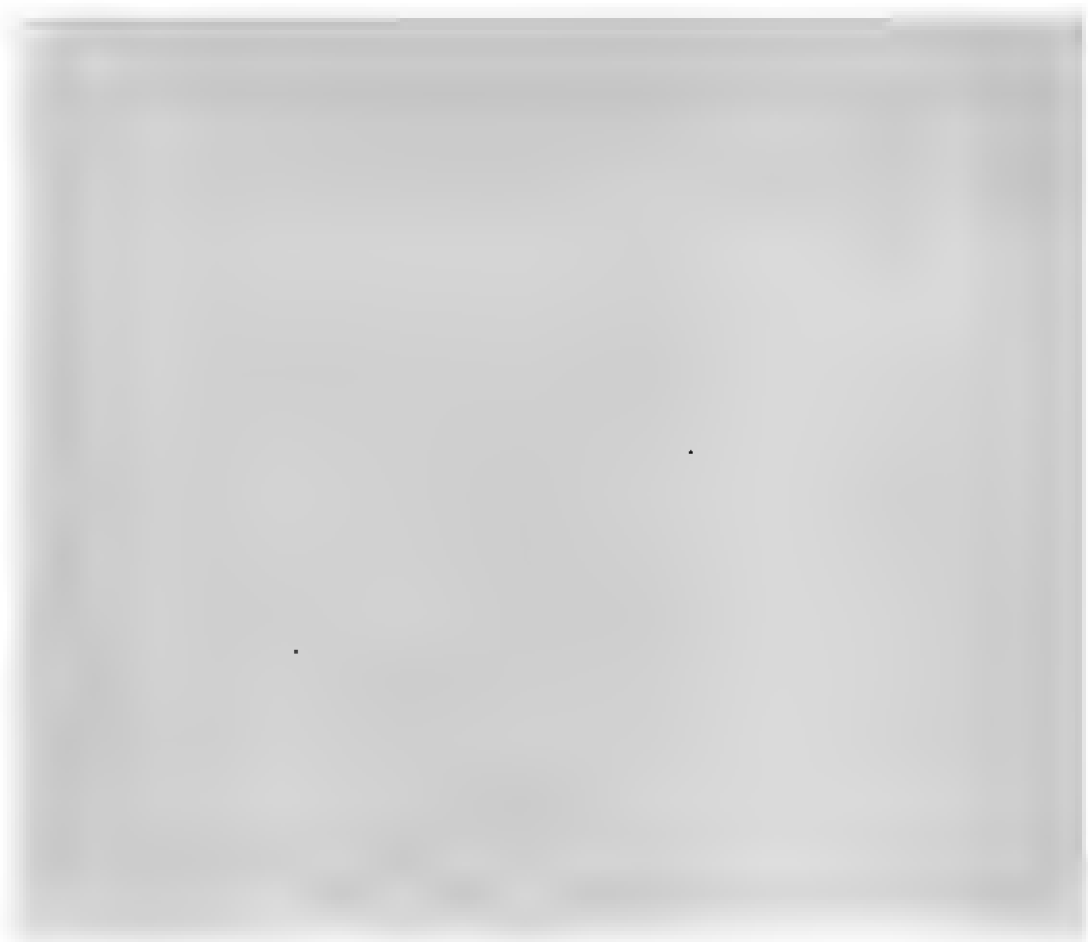


PLATE LIX

DIAGRAM SHOWING ABDOMINAL SECTION IN MEDIAN LINE IN UPPER THREE-FOURTHS OF ABDOMINAL WALL.

a skin, *b* fat; *c* aponeurosis of external oblique abdominal muscle, *d* aponeurosis of internal oblique abdominal muscle, divided, the upper half passing with the aponeurosis of the external oblique in front of the rectus abdominis muscle (1) the lower half joining the transversa fascia and passing behind the rectus abdominis muscle, *e* transversalis fascia, *f* peritoneum; *g* line of incision. The lower layer of the aponeurosis of the internal oblique abdominal muscle; the transversalis fascia and the peritoneum are usually very closely united, although they can usually be easily separated in the absence of inflammatory processes.



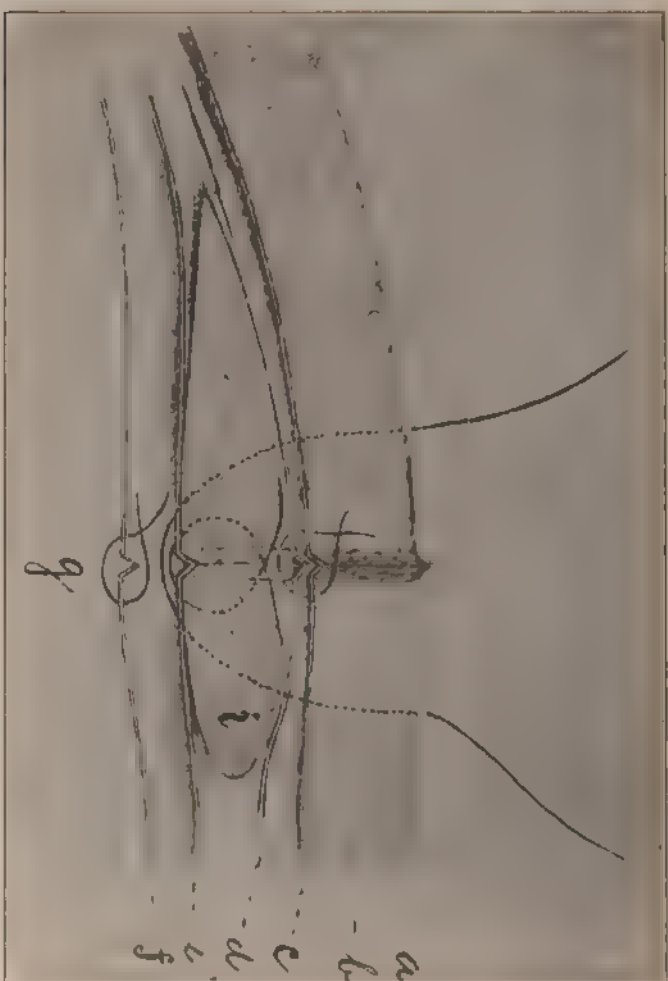
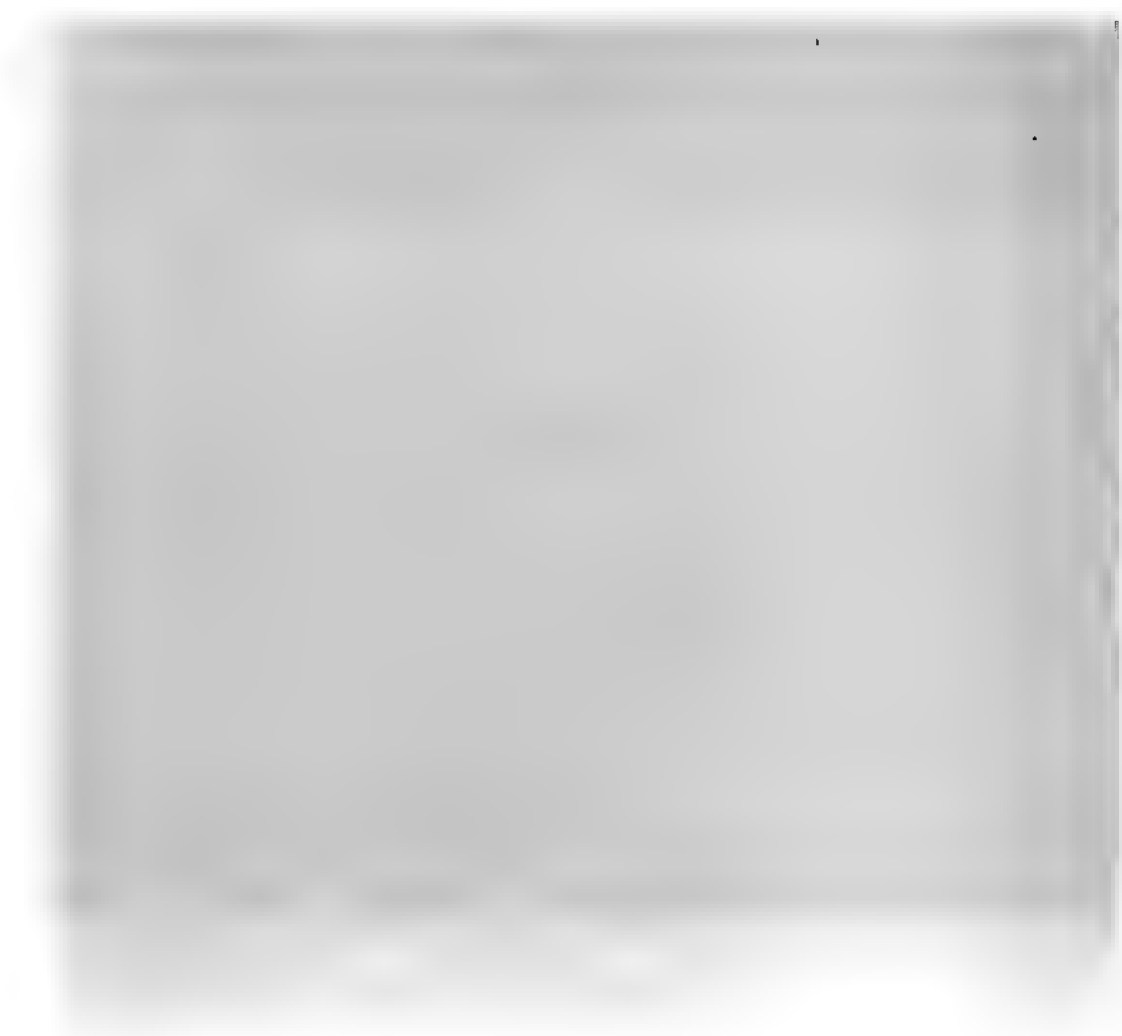


PLATE LX.
 ABDOMINAL WALL IN LOWER ONE-FOURTH OF DISTANCE BETWEEN STERNUM
 AND PLICIS.

Showing the entire aponeurosis of the internal oblique abdominal muscle extending in front of the rectus abdominis muscle (*d*) together with the aponeurosis of the external oblique (*c*). All sutures are in place the silkworm gut suture extending through all layers down to, but not through, the peritoneum (*f*) the rectus muscle (*i*) and the aponeurosis of the internal (*d*) external (*c*) oblique, each being sutured separately with catgut.



After each layer has been sutured carefully, the silkworm gut sutures are tied over all. We believe that it is most important never to draw any of these stitches too tightly for fear of causing pressure necrosis.

A narrow pad of sterile gauze is laid upon the wound and then the abdominal wall is supported with two straps of rubber adhesive plaster, at least two inches wide, in order to relieve the tension upon the sutures.

Principles of Cure.

It does not matter in what portion of the abdominal wall the ventral hernia following an abdominal section may occur, the principles concerned in its closure are always the same. The cicatricial tissue is carefully excised, the different anatomical layers are dissected out and then united with deep silkworm gut sutures, while each layer is united separately with buried sutures of chromicized catgut which may be applied in continued or interrupted form.

As most of these herniæ occur either after appendicitis operations in the right inguinal region, or in the median line between the umbilicus and the pubis, we also illustrate the operation in the latter variety.

In this position our dissection must expose the deep fascia composed of the aponeurosis of the external and internal oblique abdominal muscles, the rectus abdominis muscle on either side and the transversalis fascia and peritoneum which are closely united.

In Plate LVII these layers are shown, the silkworm gut stitches being in place but not tied. The peritoneum and transversalis fascia have been united by means of a continuous catgut suture passing over the silkworm gut sutures so that the latter when tied will bring up the peritoneum and thus prevent the formation of dead spaces between this and the posterior surface of the recti-muscles.

The interrupted stitches have been passed through the recti muscles in the upper part of the wound and tied and two others have been inserted in the lower part of the wound and left untied in order to show the deeper stitches.

The deep fascia, composed of the aponeurosis of the internal and external oblique abdominal muscle, which is the most important layer, will be carefully sutured over this, as shown in Plate LXI, and then the deep silkworm gut sutures will be tied and a row of superficial sutures applied for coaptation of the skin, as shown in Plate LXII.

A similar dressing will be applied as described above and the abdominal walls will be supported with rubber adhesive plaster as before.

HERNIA OF THE LINEA ALBA.

Typical Case.

A gardener by occupation, forty-six years of age, gives the following history: He has always been in good health, with the exception of having had an attack of mountain fever lasting ten weeks, from which he suffered twenty years ago.

He does not remember having suffered any injury, but he has had a number of periods of intoxication lasting for several days at a time, during which he might easily have sustained some injury without knowing it. Six years ago he noticed a small swelling in the median line half-way between the end of the sternum and the umbilicus. This has increased steadily until it has attained the size of a hen's egg. Usually he has had simply a feeling

of weight in this swelling, but occasionally it is quite painful for several days. There is a slight decrease in the size of the swelling at night and a slight increase when working hard.

Patient is well nourished, thoracic and abdominal organs normal, appetite good, bowels constipated. Two inches above the umbilicus, in the median line, there is a swelling as large as a hen's egg, not painful on pressure, semi-fluctuating, no impulse upon coughing, not reducible upon pressure. In all other respects the physical examination has resulted negatively.

Judging from the consistency of the tumor, from its oval, slightly lobulated form, and its subcutaneous location, it is likely that it is composed of fatty tissue. It may consequently be a lipoma. Were there a history of traumatism immediately preceding its appearance, or were there an impulse upon coughing, we could make a positive diagnosis of a hernia of the linea alba.

Differential Diagnosis.

There are certain peculiarities in this case which point distinctly to the latter diagnosis:

(1) There has been a disturbance of the stomach since the appearance of the swelling, which is due in many cases of hernia of the linea alba to the fact that the adherent omentum interferes with the normal motility of the stomach. The opening in the linea alba is frequently so small that an impulse upon coughing is not possible. This is still further interfered with by the extensive adhesions of the omentum to the hernial sac, which is frequently not a true sac composed of peritoneum and transversalis fascia, but simply a space in the ruptured tissues. This disturbance is sometimes so great that the patient is entirely disabled.

(2) The tumor varies in size, decreasing a little at night and increasing perceptibly upon making severe exertion for a considerable time, as upon working very hard. Although there is no impulse upon coughing or straining it seems that more of the tissue of the omentum becomes forced through the small hernial opening when there is long-continued abnormal intra-abdominal pressure than when this is normal.

(3) The swelling becomes painful at irregular intervals, especially when the patient engages in hard work. We have repeatedly seen strong, otherwise perfectly healthy men entirely disabled for work by the pain resulting from a hernia in this region, so small that it had escaped the notice of physicians and surgeons for years, the patient not taking it to be of sufficient importance to require their attention.

(4) The swelling usually appears suddenly after an injury, such as a sharp blow upon the linea alba.

Considering all of these facts it seems likely that this is a hernia of the linea alba, although we cannot be absolutely positive in our diagnosis until the mass has been exposed.

Etiology.

In this case the etiology is not very clear on account of the fact that it is likely the patient's powers of observation were greatly impaired at the time at which the condition was produced.

Indications for Operation.

The amount of suffering is not sufficient to disable the patient from performing his work, but he suffers from gastric disturbances and from



PLATE LXI

CLOSURE OF ABDOMINAL WOUND

Represents the abdominal wound in the median line with each layer sutured separately, but the deep sutured, gut sutured still ant eq. (a) represents the strong deep fascia composed of the aponeurosis of the internal and external oblique abdominal muscles upon which the permanency of the closure and the absence of post-operative hernia depends.

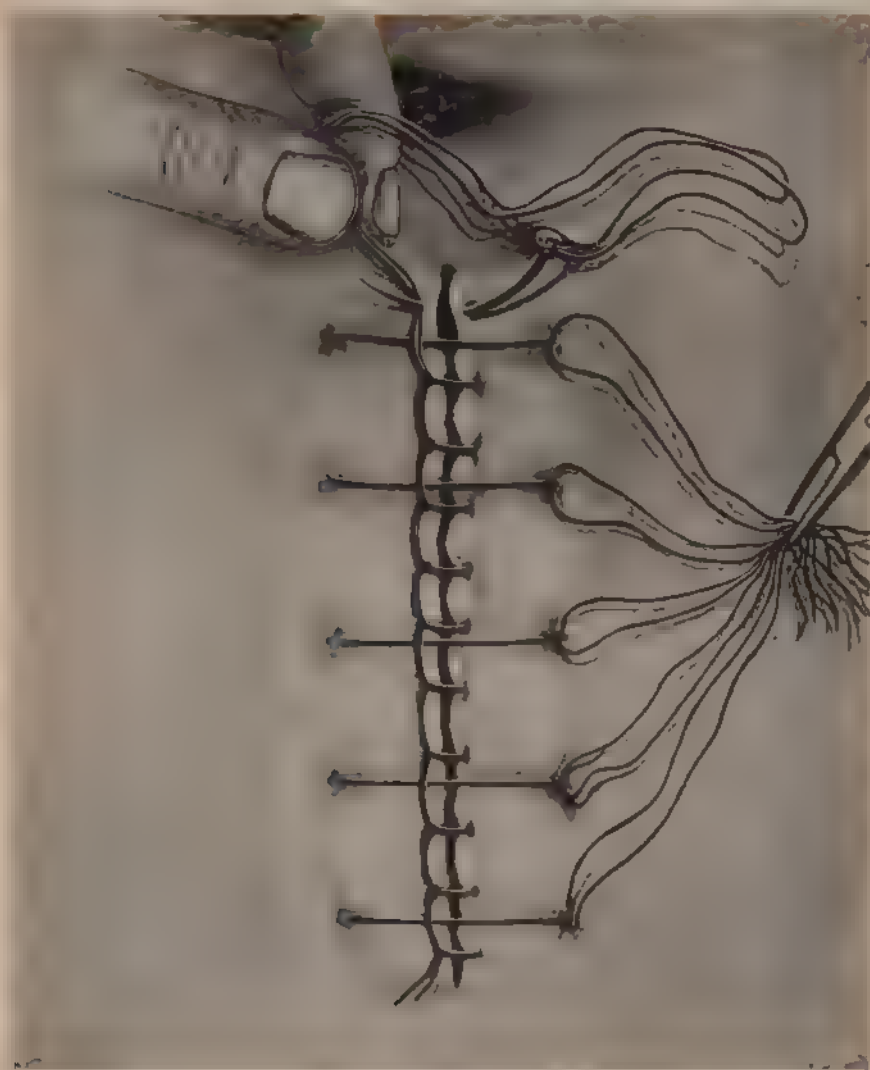


PLATE LXII.

CLOSURE OF ABDOMINAL WOUND

Represents the deep silkworm gut sutures tied loosely so as to avoid pressure necrosis and a continuous coaptation stitch for the accurate adjustment of the edges of the skin



pain in the region of the swelling whenever he labors hard, and the periods of acute irritation are becoming more numerous, and the extent of the irritation more severe constantly. Moreover, the swelling is becoming more and more sensitive to pressure from the clothing.

Were it possible to reduce this swelling into the abdominal cavity its retention by means of a truss might be considered, but experience has shown that this would not succeed.

The patient is not in any immediate danger, because the opening is too high in the median line to permit the protrusion of a portion of the small intestine, and it is too small to engage either the stomach or the transverse colon. There is consequently no danger of strangulation.

The patient is familiar with all of these facts and has chosen the operation for the purpose of securing relief from pain and to increase his working capacity.

The preparatory treatment is the same as in all abdominal sections. Were the patient very obese, we would advise treatment for the relief of this encumbrance.

Operative Technique.

A longitudinal incision twelve centimeters in length is made over the most prominent portion of the swelling, through the skin and superficial fascia, which exposes a flattened, oval mass as large as a hen's egg. Lifting up the edges of this mass the finger reaches a point in the aponeurosis forming the linea alba which is defective. At this point the latter has a perforation which would admit two fingers were it not occupied by a projection of the fatty swelling which we have exposed. The latter is lobulated, quite vascular and is slightly adherent to the surrounding tissues. It is not surrounded by a true hernial sac. It has consequently come through in the defect in the abdominal wall and we have before us a hernia of the linea alba, and the fatty mass is composed of omentum which has been forced out of the peritoneal cavity through this opening.

It is impossible to replace the omentum into the peritoneal cavity, and if it were it would not be desirable to do so because it has been so completely changed from a thin, delicate, protecting sheet into a clumsy mass, that it would probably give rise to irritation were it replaced. We will consequently transfix the narrowed portion, at the point where it issues from the opening in the aponeurosis, with a double catgut ligature, tie it in halves, cut away the mass a sufficient distance outside of the ligature to prevent slipping, and drop the stump into the abdominal cavity.

It frequently happens that the fat contained in a hernia of the linea alba is partly or entirely composed of pre-peritoneal fat instead of omentum. These patients suffer even greater pain than those in which the mass is composed entirely of omentum. When this mass is removed the pedicle is simply reduced through the hernial opening into the pre-peritoneal space.

The remaining steps of the operation vary according to the character of the opening. If this is small and circular, and if its edges are thick, it is probably quite as unnecessary to do anything toward closing it as in femoral hernia. As soon as the ring is empty it will close spontaneously.

If the opening is oblong or triangular in form but not more than two or three centimeters in length with substantial edges, these may be brought together with two or three buried chromicized catgut sutures. If, however, the opening is oblong and its edges thin, as in this case, it is likely there

would be a recurrence unless the defect were repaired in a more substantial manner.

In order to secure favorable conditions for a permanent cure in these cases it is necessary to carefully expose each one of the various layers composing the abdominal wall at this point and then to close the wound precisely in the manner described in operations for ventral hernia following abdominal section in the median line. The anatomical layers in this portion of the linea alba from without inward are as follows: 1, skin; 2, superficial fascia; 3, fat; 4, strong fascia composed of the aponeurosis of the external oblique abdominal muscle and the outer half of the fascia of the internal oblique; 5, rectus abdominis muscle; 6, the inner half of the fascia of the internal oblique abdominal muscle; 7, the transversalis fascia; 8, peritoneum. The last three layers mentioned are usually so closely united with each other that they appear as one.

Having exposed these layers we close the wound as shown in Plates LVII and LXI.

A row of silkworm gut sutures extending through all the layers down to the peritoneum are inserted but not tied. Then the deepest layer composed of peritoneum, transversalis fascia and the inner half of the aponeurosis of the internal oblique abdominal muscle is sutured with a continuous catgut suture. Now the recti muscles are brought together by means of just a sufficient number of interrupted catgut sutures to bring them in accurate apposition. The strong, deep fascia, upon which the permanency of the cure really depends, is next carefully sutured with chromicized catgut; and then the deep silkworm gut sutures are tied and, if necessary, a row of coaptation stitches is applied to adjust the edges of the skin.

In connection with this case we wish to direct attention particularly to the diagnosis of these troubles.

They are somewhat rare and almost never diagnosed until they have suffered for many years. In the meantime they usually go from one physician to another, receiving treatment alternately for the relief of gastric disturbances and neurasthenia.

HERNIA IN CHILDREN.

Example.

A boy, twenty months of age, comes with the following history: He has always been well and strong since birth and none of his functions have been impaired. There is a vague history of a fall two months ago, but nothing definite can be determined in this respect. It is quite likely that the mother imagines this from the fact that she feels compelled to account for the child's condition in some way.

Six months ago the mother noticed a swelling in the region of the left inguinal canal extending into the scrotum on that side. This swelling decreases in size when the child is in bed, but cannot be reduced while he is awake. The protrusion increases when the child cries. There is an abundance of fat in the subcutaneous tissues and it is difficult to determine whether the mass fluctuates upon palpation. An attempt has been made to apply a truss, but the child screamed incessantly when this was in place, so that it had to be removed directly. The child is otherwise normal, with the exception of having an adherent prepuce.

Differential Diagnosis.

It is often difficult to make a positive diagnosis in a child so young as this one, because it is practically impossible to keep him quiet long enough to determine the conditions present, unless he is anesthetized.

Hydrocele is the only condition, aside from hernia, which is common in children of this age and causing a swelling in this position. In one case we encountered a lymphangioma, and a congenital lipoma, or one developing shortly after birth, which is possible in this location, but so rare that it really need not be considered.

Now that the child is anesthetized, we find that the swelling can be reduced into the abdominal cavity through the inguinal canal, but as soon as the pressure is released it reappears at once. There is also the sensation to touch of reducing a mass of a definite, permanent form which would not be the case were the swelling composed of omentum or intestine contained in a hernial sac. The condition present must consequently be an irreducible hydrocele of the cord.

Etiology.

In this patient the communication between the peritoneal cavity and the tunica vaginalis evidently remained open after the descent of the testicle and gave rise to a congenital hernia. At some time later the upper end of this hernial sac closed by adhesion of its walls, and then its serous lining, instead of becoming adherent to the tissues of the spermatic cord and thus bringing about a spontaneous cure, secreted fluid and this caused the distension of this sac. Being located in the inguinal canal the latter cannot close, hence the impulse upon coughing or straining.

Indications for Operation.

So long as the inguinal canal is distended by this pouch filled with fluid it is impossible for it to close and the development of the child cannot proceed normally. The mass cannot be reduced into the peritoneal cavity thus leaving the canal free to close, neither can it be withdrawn downward. It is consequently necessary to resort to some operative measure for the relief of the condition. This can be accomplished by withdrawing the fluid by means of a cannula, but this would probably not secure permanent relief because the serous fluid would re-form unless some irritating substance was injected which would result in a sufficient amount of aseptic inflammation to cause the surfaces to adhere. For this purpose a few drops of ninety-five per cent solution of carbolic acid has been injected, or a larger quantity of five per cent solution of the same substance, or a few drops of tincture of iodine. None of these substances is, however, certain to accomplish the end desired and none of them entirely harmless. We will consequently choose a method which is not connected with more danger and which will result in a permanent cure.

Technique of Operation.

An incision is made over the most prominent portion of the swelling parallel with the inguinal canal and down to the hernial sac. It is now apparent that the sac is distended with fluid. We incise it and permit the fluid to escape. We find a smooth sac containing nothing but about thirty cubic centimeters of a clear fluid. The sac is easily separated from the surrounding tissues. At its upper end it is found closed by means of scar tissue which has united its walls. It is withdrawn from the inguinal canal

a little further, then transfixed with a needle threaded with catgut and tied. Then the sac is cut away, care being taken to leave a sufficient amount of tissue beyond the ligature to prevent slipping. The stump is permitted to retract within the abdominal cavity. No attempt is made to close the inguinal canal, because this occurs spontaneously in children as soon as the sac is removed. Suturing the skin completes the operation.

Carefully compiled statistics have shown that of all the herniæ encountered in the adult less than five per cent have existed since childhood, and also that of all children under six years of age suffering from hernia seventy-three per cent will heal spontaneously, without any form of treatment, before the age of thirteen, consequently the relative number of herniæ in children requiring operative treatment must be very small.

Conditions Favoring Spontaneous Cure.

Spontaneous cure is accomplished, (1) By the late closure of the inguinal canal, which should have occurred before birth; (2) By the broadening of the pelvis. The parietal peritoneum enlarges at the expense of the mesentery; the latter being thus shortened prevents the entrance of the intestines into the inguinal canal; (3) By the displacement of the internal abdominal ring with the growth of the child; (4) With the growth of the child a number of the predisposing causes are eliminated. These are:

Predisposing Conditions to Overcome.

(a.) *Abnormal intra-abdominal pressure.*—There can be no doubt that the most important direct cause of herniæ in children is an abnormal intra-abdominal pressure. This may be due: 1, To gaseous distension of the stomach and bowels, caused by faulty feeding and consequent indigestion; 2, To great pressure exerted during the act of defecation, on account of constipation. 3, To the same condition due to obstruction on account of phimosis. 4, To severe vomiting. 5, To long-continued coughing. In connection with all of these conditions, it is to be remembered that children with digestive disturbances necessarily suffer much from pain, and the exertion incident to crying will greatly increase the existing abnormal intra-abdominal pressure. In order to quiet the child the mother will nurse it at irregular intervals and this will again increase the digestive disorder, and this, in turn, the intra-abdominal pressure and pain.

(b.) *Increased intra-abdominal pressure due to coughing.*—We have observed cases in which the herniæ healed regularly during the summer months, but reappeared in the autumn as soon as the children acquired coughs, which lasted almost all winter. By the time spring arrived the herniæ had attained considerable size, only to heal again during the summer while the patients were free from coughs. By placing these children in bed and elevating the lower end sufficiently to make an angle of twenty degrees and giving them remedies to relieve the cough, the herniæ disappeared within six weeks. Then advising the mothers to give the children cold baths every day and to bring them for inspection often enough to keep the condition under control, and giving them codliver oil and malt extract as soon as the cold weather appeared, they went through the next winter without coughs and consequently without a recurrence of the herniæ. In the same manner children who are suffering from obstruction to the upper air-passages, on account of enlarged tonsils, nasal adenoids or polypi and consequent conditions, will rapidly recover from their herniæ if these conditions are relieved by proper treatment.

(c.) *Increased pressure due to gaseous distension.*—It is very usual for the children who are brought into the hospitals for the treatment of hernia to have greatly distended abdomens, due to digestive disorders resulting in gaseous distension of the stomach and intestines. If this occurs in nursing infants the mother should be instructed to nurse the child at regular times. Her own habits and diet should also be regulated. If the child is constipated this condition should be relieved. Aside from this the mother must be instructed never to carry the child, because she will not follow the advice of keeping it in the inverted position and, consequently, will increase the intra-abdominal pressure whenever she picks up the infant. It should sleep in a separate bed with the lower end elevated sufficiently to make an angle with the floor of about twenty or thirty degrees. This will keep the hernial sac empty of intestines and omentum and will very greatly assist in the obliteration of the hernia. If the mother's milk continues to give rise to indigestion, notwithstanding every precaution available for making it wholesome, it is often best to place the child partly or wholly on artificial food, at least for a time. Above all things, however, it is important to impress the mother with the necessity of being regular in feeding the child and to again place it in its bed as soon as it has been nourished, or, better still, to lean over the child's bed and nurse it without disturbing its partly inverted position.

We have repeatedly placed these children in the hospital and sent the mother, who was exhausted from overwork and care of the sick child, home to rest, permitting her to come to the hospital morning, noon and night to nurse the child. After the first day or two the mother becomes rested, her journeys to and from the hospital compel her to be out of doors, and the fact that she is relieved of the care of the child gives her the necessary rest and sleep. In the meantime her milk improves, the child becomes accustomed to lie quietly in bed and to take its nourishment regularly, its digestion improves, the gaseous distension disappears, and with it the abnormal intra-abdominal pressure, which is still further relieved because the child sleeps most of the time and seldom cries. After the child has been in the partly inverted position for a few days the hernial sac remains empty so long as this position is continued, even if he strains and cries.

(d.) *Increased intra-abdominal pressure during defecation, due to constipation.*—Children suffering from hernia should not be allowed to become constipated, because the increased intra-abdominal pressure necessary to accomplish the evacuation of the bowels in constipation is in itself sufficient to prevent a hernial aperture from closing. This is one of the most common causes of hernia in children, and one of the easiest to be eliminated.

(e.) *Increased intra-abdominal pressure due to obstruction to the passage of urine as a result of phimosis.*—That phimosis is a frequent cause of hernia in children is plain from the fact of the greater frequency of umbilical hernia in male than in female children. The greater frequency of inguinal hernia in male children can readily be accounted for by the difference in the anatomic structures, but this is not the case in umbilical herniæ, which is also shown statistically to be more common in male than in female children. It has lately been suggested that phimosis cannot be an important cause of hernia in children, because if this were the case the Jewish nation must necessarily be much freer from hernia than others. This, is, however, not the case. In fact, it has been shown by statistics,

especially in Russia, that at the age of twenty to twenty-one proportionally more Jews than Christians are afflicted with hernia. This, however, may be explained by the fact that the Jews are more subject to hereditary diseases of all kinds, on account of the system of intermarriage in families.

If the phimosis is relieved, either by circumcision or by dilatation of the prepuce, and the child kept in bed for four to six weeks with the foot of the bed elevated, the hernia will almost invariably be cured. During the same time the diet and the bowels must be carefully regulated, and it is doubtful which of these three means has been of the greatest importance in producing a cure. It is surprising how rapidly the opening will contract under these conditions. Moreover, during this time the patient acquires regular habits which may afterwards be easily maintained if their importance is explained to the mother, and especially if it is impressed on her that by following the directions, which will naturally appeal to her on account of their simplicity and reasonableness, she will be able to make operative treatment unnecessary.

That all of these conditions are of the greatest importance may be demonstrated practically, with the greatest ease, by comparing the relative frequency of hernia in children of the very ignorant poor, of the intelligent poor, and of the well-to-do. In the former class, after the child is weaned, but little attention is given to its diet, to the state of its bowels, and to the condition of the prepuce in boys, and consequently herniæ are very common, while they are much less common in the second, and still less in the third class.

STRANGULATED HERNIA IN CHILDREN.

If a strangulated hernia in a child cannot be easily reduced, under complete anesthesia, by taxis, the child being held in the inverted position during the manipulations, it is undoubtedly wiser to relieve the danger by an operation, because the intestinal wall in children is very delicate and easily injured by taxis. In our experience the hernial opening has always been very narrow; still we have always succeeded in replacing the hernial contents, without enlarging the opening, by first drawing out more intestine and then gradually replacing it, the child being maintained in the inverted position.

Technique.

If the hernia is an acquired one, which is not common in children, the sac is carefully dissected free to a point within the abdominal cavity. It is then ligated and removed and the ligated stump permitted to retract into the peritoneal cavity.

If the hernia is congenital it is best to dissect up the neck of the sac for about an inch, and leave the portion surrounding the testicle to form a tunica vaginalis, while the upper portion is carefully dissected up to a point within the peritoneal cavity; it is then ligated, the superfluous portion is cut away and the stump permitted to retract into the peritoneal cavity, as in case of the acquired hernia. It is thus only necessary to close the skin and the opening will close completely in from four to six weeks if the child is kept in bed with the foot of the bed elevated.

If it is possible to reduce a strangulated hernia in children by taxis, the irritation, caused primarily by the strangulation and secondarily by the manipulation, seems to favor closure of the hernial opening. We have repeatedly seen this occur within six weeks if the child was kept in bed in the partly inverted position.

Unfavorable Cases.

The most unfavorable cases are those in which the abdominal walls are congenitally weak, a condition which seems to be hereditary in many patients. Again, of these cases those in which there are three distinct areas of weakness—the abdomen of three hills described by Malgaigne—seem to be least favorable of all. In this class surgical treatment may become necessary, and here it is well to perform the typical Bassini operation, or that described by Ferguson, the important point in the operation being to secure an accurate closure of the inguinal canal to make up for the natural deficiency in the tissues. Two precautions should be borne in mind: 1, The stitches should be tied very loosely, in order not to cause pressure-necrosis of the already weakened tissues. 2, The tissues of the cord in the male should be manipulated very carefully for fear of causing an atrophy of, or preventing the full development of, the testicle. This is especially important in these cases because herniæ in this class of patients are very likely to be double, and if both testicles should atrophy the patient would be permanently injured. In this class frequently no truss will retain the hernia.

There is but one other condition which justifies the operative treatment of hernia in children, and that is when, on account of adhesions, the hernia, although not strangulated, is still irreducible. In this class a truss cannot be worn with benefit, because it presses on the hernial contents, usually omentum, instead of the empty canal; moreover, the opening not being empty, its closure is necessarily impossible unless the adhesions are absorbed, which, if occurring at all, necessarily requires a long period of time. In this variety of hernia, unless it be complicated with the form just described, it is not necessary to do anything further than in case of strangulated hernia. The hernial sac being removed, the opening will close spontaneously.

In operation for relief of femoral hernia in children it is never necessary to do anything beyond dissecting out, ligating and cutting away the sac, permitting the stump to retract into the peritoneal cavity, and closing the skin. These cases are exceedingly rare. We have never seen a strangulated femoral hernia in a child, and only once an irreducible one due to an adherent omentum, which necessitated an operation.

Use of Trusses.

Too much stress has been laid upon the importance of trusses in the treatment, and too little on removing the causes, of hernia in children.

It is far easier to retain a hernia and thus encourage the closure of the hernial opening, by first relieving the abnormal intra-abdominal pressure and then applying the truss simply as an aid, than it would be to accomplish the same object by the use of the truss alone.

If it is at all possible it is always best to place the child in bed in the inverted position, and to reduce the intra-abdominal pressure by the methods which have been described, before making use of a truss at all. Then, if it is not possible to maintain this position sufficiently long to obtain a cure it is well to apply a perfectly-fitting truss.

The fact of using a truss does not make the other precautions unnecessary. The child should still be cared for so as to remove intra-abdominal pressure from every cause, and the foot of its bed should still be elevated in order to make use of gravity in keeping the hernia empty and to facilitate the shortening of the mesentery.

Pertinent Conclusions.

The following conclusions seem to cover the treatment of hernia in children:

1. The development of herniæ in children is favored by: (a) faulty development of the abdominal wall; (b) insufficient strength in the tissues involved in closing the umbilical, inguinal or femoral openings; (c) abnormal intra-abdominal pressure; (d) unclosed condition of the tunica vaginalis.

2. The causes (a) and (b) are likely to be inherited.

3. The abnormal intra-abdominal pressure is due: (a) to gaseous distension resulting from improper feeding; (b) to the exertion necessary to accomplish defecation in case of chronic constipation; (c) to the same exertion necessary to evacuate the bladder on account of obstruction due to phimosis; (c) to severe, long-continued coughs.

4. A large majority of all cases of hernia in children will heal spontaneously if the increased intra-abdominal pressure is relieved, the hernial sac being kept empty.

5. This may be accomplished by means of a truss or, much more rapidly, in inguinal and femoral hernia, by placing the child in bed with the foot of the bed elevated, the time required usually not exceeding six weeks.

6. Children with a tendency to the formation of hernia should be guarded against developing coughs.

7. Their diet should be given at regular times and chosen with a view to avoiding gaseous distension.

8. Constipation should be entirely prevented.

9. In case of boys, phimosis should be relieved, if present.

10. Badly-nourished and badly-cared-for children of the poor should be treated in hospitals, being placed in bed in the inverted position, the cause of increased intra-abdominal pressure being removed at the time by proper treatment.

11. Operation is indicated (a) in strangulated hernia; (b) in irreducible hernia due to adhesions; (c) in case the opening is unusually large in a free hernia, especially if the condition is hereditary and the hernia cannot be retained by means of a truss; (d) in reducible hydrocele.

12. Except in class c, the operation should consist simply in carefully dissecting out the sac, ligating it within the abdominal cavity, cutting away the sac and permitting the stump to retract within the abdominal cavity, and simply closing the wound in the skin.

13. The recumbent position, with the foot of the bed elevated, is of very great importance in the operative as well as in the non-operative treatment of herniæ in children.

14. If the child cannot be kept in this position sufficiently long, a well-fitting truss should be worn night and day until there has been no protrusion for at least six months, at the same time the necessary precautions being constantly taken to guard against intra-abdominal pressure from any cause.

HERNIA IN OLD MEN.

It frequently happens that a male patient can easily retain his hernia by means of a truss until he has attained the age of about sixty years, when he is no longer able to do this, and consequently seeks relief through a surgical operation.

He may have grown obese or his tissues may have become soft and less able to resist intra-abdominal pressure, but there is an important factor in the increased intra-abdominal pressure required in emptying the bladder on account of an obstruction to the passage of the urine, caused by an enlarged prostate gland. This is very common in old men.

In quite a large proportion there will be a rapid reduction in the size of the prostate gland if either a vasectomy or an orchidectomy is done. Both of these operations can be made very easily in connection with herniotomy without increasing the danger to the patient, and as both remove some of the loose tissue in the inguinal canal they favor permanency of cure in two ways: 1, by making the union between the layers to be united more perfect, and 2, by decreasing, indirectly, the excessive intra-abdominal pressure by reducing the size of the prostate gland.

In many of these cases it is undoubtedly best to perform a perineal prostatectomy as well as a herniotomy. If the patient's general condition is good both of these operations may be accomplished at the same time, if not, it is probably best to make a herniotomy together with an orchidectomy first, and if this fails to produce a sufficient atrophy of the prostate gland to perform prostatectomy later.

If the prostatic trouble is very pronounced so that the patient has to get up several times during the night and strain to urinate, it is well to relieve the prostatic obstruction before operating upon the hernia, for the constant straining is likely to interfere with a perfect healing of the tissues thus bringing about a relapse of the hernia.

The greatest proportion of strangulation occurs in patients past middle life. It is not uncommon for a patient to have a hernia for forty or fifty years that has always been easily reducible, and then become suddenly strangulated. In the majority of cases the hernial opening increases in size with old age, and the protrusion constantly slips outside of the truss, increasing the patient's discomfort and placing him in constant danger of strangulation.

In operating upon old people one frequently finds that the conjoined tendon has been almost completely obliterated. When this condition exists, it is well to transplant the cord and close the lower angle of the wound as closely as possible. When the obliteration of the conjoined tendon is very pronounced this lower angle can be closed best by opening the sheath of the rectus muscle and utilizing that muscle in the closure, after the method of Bloodgood, as described in a previous section.

STRANGULATED HERNIA.

Type of Case.

A married woman, forty-six years of age, has just been brought to the hospital. From her daughter we learn the following history: The patient has been married for twenty-six years; has never been very strong, but always comparatively well. She is the mother of four healthy children. For many years she has felt a weakness in the region of the left groin and since twelve years old has known of the presence of a femoral hernia, which, however, has given rise to but little distress except when she has worked beyond her strength. Occasionally the hernia has been painful and the patient has experienced difficulty in reducing it, but this has never been serious in character and she has always succeeded in obtaining relief by lying down and applying hot cloths to the part for an hour or two.

Three days ago the patient suddenly became severely nauseated and had great pain in the abdomen. She attributed this to something eaten and imagined that it would soon improve. She consequently made use of home remedies and did not send for her physician until about sixteen hours ago. When he arrived he found the patient very ill. She still continued to vomit, there had been complete obstruction to the passage of gas and feces, the abdomen was moderately distended with gas and the abdominal walls were tense. In the region of the left femoral ring there was a hard mass the size of a hen's egg. The pulse was a little over 100 and the temperature 101° F.

The physician made a diagnosis of strangulated femoral hernia, but as the patient did not suffer from severe pain in the vicinity of the hernia he did not lay very great weight upon this part of the diagnosis. He elevated the foot of the bed in order to make use of gravitation for the purpose of reducing the hernia, gave a hypodermic injection of morphia to relax the muscles, directed the patient to remain in the position assumed and continue the application of hot fomentations. He also forbade the giving of any kind of food by mouth.

The physician then left the patient and returned after six hours, only to find her very much worse in every respect. He then advised an immediate operation, but the husband could not be found for seven hours more, and by the time the latter was convinced of the necessity of an operation the patient was in the present extreme condition. Her face is pale, lips blue, respiration very shallow, pulse imperceptible, and she is without doubt in a dying condition. The pupils are becoming more and more dilated, indicating that death will occur within a few moments.

Such a case is unusually instructive because the conditions present are so frequently encountered in practice.

Prognosis.

In the discussion of hernia operated for the radical cure, when not strangulated, the fact was pointed out that the operation is almost absolutely safe, the death of a case depending upon an accident. The same is true in operation for the relief of strangulated hernia at the beginning of the attack, because the only additional element, the strangulation, may be relieved without difficulty and without danger to the patient so long as there has been no injury to the strangulated intestine. Consequently every death following a strangulated hernia—barring the accidents which may occur in connection with any operation—is due to the fact that a physician has not been called at the beginning of the attack, or his advice to obtain immediate relief has not been accepted, or the physician himself has wasted valuable time.

Prompt Operative Measures Necessary.

There can be no doubt but that all temporizing in the treatment of strangulated hernia should be strongly condemned, because cases in which relief is obtained in this manner could all be relieved by manipulation of the hernia under an anesthetic, and those that are not relieved would recover were they operated early. Every year thousands of patients lose their lives unnecessarily from strangulated hernia because time is wasted either on account of their own ignorance or stubbornness, or because of carelessness in examination by the physician called or his lack of decision in obtaining relief at once. Moreover, it should be remembered that any practitioner who has sufficient intelligence and training to have clean hands and instru-

ments, and a fair knowledge of what to do, will save a larger proportion of cases suffering from strangulated hernia by operating at the beginning of the attack than will a surgeon of the very greatest skill and training after the tissues involved have become gangrenous.

At this point we wish to make a suggestion which seems to be of great practical importance so long as patients and their friends are justly afraid of surgical operations for the relief of strangulated hernia because many of their friends who have submitted to this operation have not recovered. It is difficult for the layman to understand that his friend died, after an operation for the relief of strangulated hernia, because the operation was performed when he was already in a hopeless condition; for this fact should have prevented the operation which was at least useless, as was shown by the result. It is difficult for him to understand why his own chance of recovery should be better than his friend's, inasmuch as his friend was urged to submit to an operation with the same arguments that are being employed in his case. In other words, the large number of deaths following operations for strangulated hernia, where the operation had been postponed until the patient was in a hopeless state, prevents the operation in the case under immediate consideration until it, likewise, is too late to be of value.

This prejudice can usually be overcome in the following manner: Describe to the patient the condition which is present; tell him that a loop of intestine is caught in a ring and constricted as tightly as his finger would be were a string tied about it sufficiently firm to prevent all circulation of blood. He will understand that this must soon be followed by death of the tissues and that then the contents of the intestines will leak into the abdominal cavity and that this will be followed very speedily by his death. Tell him that you will make every effort to reduce the strangulation by manipulating the tissues, in order to induce the intestine to slip back through the ring.

Taxis.

Place the patient on a couch or a board, or if this cannot be obtained take a door out of its frame and lay the patient on it; then elevate the lower end of this so that it will be at an angle of about 40° with the floor. Have him draw up his knees and then manipulate the protruding portion gently, so as not to cause any injury to the intestine, remembering that the longer the strangulation has existed, the more gentle must be the manipulations.

It is well to permit the patient to manipulate the hernia himself while he is in this position, because he is frequently more experienced, and consequently may be more successful than the physician. If reduction is accomplished, it is well, if not, it is best to explain to the patient that by relaxing the muscles, by the use of an anesthetic, you may still be successful, but if this fails, it will become necessary to sever the circular band which prevents the reduction of the hernia.

This will seem so reasonable to the patient that in our experience, with only one exception, the patient has always consented when the conditions have been placed before him in this manner. One substitutes the object, namely, the reduction of the hernia, for the operation in the mind of the patient. This is really important.

Operative Preparation.

It is best to permit the patient to continue in the inverted position while the necessary preparations are being made, which should be very simple, as described in the section on preparation for operation. If a colleague is

available he should be called in the meantime, if not, this should not interfere with the plan of action, because time is the element of greatest importance in these cases.

If the patient is in a hospital it is wise always to anesthetize the pharynx by spraying it with a four per cent solution of cocaine in water, then insert a stomach tube and carefully wash out the stomach, because these patients frequently vomit during the operation and inspire the offensive material which has decomposed in the stomach, a pneumonia perhaps resulting. In a private house, especially in the country, these preparations may not be possible, although it is well always to carry a stomach tube. In this case the patient may be protected by being kept in an exaggerated Trendelenburg position throughout the anesthesia, because in this way the vomited material will escape from the mouth by gravitation before it can be inspired.

When the patient has been thoroughly anesthetized another attempt may be made to reduce the hernia by manipulation, and if this fails, herniotomy should be performed at once. During these manipulations it is again necessary to bear in mind that if the strangulation has lasted only a few hours a considerable amount of force may be exerted with safety, while it is not wise to use any force if the strangulation has existed for more than twenty-four hours for fear of rupturing the intestine.

Symptom Resume.

Before describing the operation we wish to direct attention once more to the above history, which is quite characteristic in many respects. 1. The onset was sudden. 2. There were severe spasmodic pains in the abdomen. 3. The patient suffered from nausea and vomiting and consequently attributed her trouble to an error in eating. 4. There had been complete obstruction to the passage of gas and feces. 5. There was a history of the presence of a hernia. 6. A mass existed in the groin. 7. The patient felt severely ill from the beginning. 8. She went into a hopeless condition of collapse very suddenly.

The physical examination, when first seen by the physician at the beginning of her collapse, showed a patient with a bad facial expression, the tongue was thickly coated, temperature and pulse not very high, but the pulse bad in character, the patient was restless, the abdominal walls were tense, the abdomen somewhat distended with gas. The peristalsis of the small intestines could be distinguished through the abdominal wall to some extent. There was complete obstruction to the passage of gas and feces. In the inguinal region there was a very tense swelling which could not be reduced.

Differential Diagnosis.

The history of a reducible hernia which had existed for a considerable period of time, and the presence of an immovable mass in the inguinal region at the point at which the reducible hernia could be located by the patient, would in itself warrant a positive diagnosis of strangulated hernia in the presence of complete intestinal obstruction.

Without the previous history of a reducible hernia the mass in the groin might be due to a severe inflammation of the inguinal lymph glands. We have seen a case of acute intestinal obstruction due to perforative appendicitis, complicated with bubo, in which the latter might have been diagnosed as a strangulated hernia had not the attending physician treated the patient previously for a specific urethritis. The most common mistake in diagnosis

is that of acute gastritis, because the physician is willing to make a diagnosis from the history alone without making a physical examination of the abdomen, the patient either neglecting to mention the fact of having a hernia or this fact being passed over without notice. An acutely inflamed tumor in this region may be mistaken for a strangulated hernia.

In quite a number of these cases which have come under our observation the patient insisted that the hernia had been irreducible for many years and that it could consequently not be the cause of the severe gastric disturbances. Moreover, the attack came on directly after some indiscretion in eating and must consequently depend upon this and not upon the hernia, which had remained unchanged. The unusual hardness of the hernia is supposed to correspond to the tension in the abdominal walls, due to the intra-abdominal irritation. In this manner a strangulated hernia is mistaken for a simple irreducible hernia which is caused by the adhesion of a portion of the omentum within the hernial sac.

In these cases the operation usually shows that a loop of intestine has slipped into the hernial sac alongside of the omentum and has become strangulated by the sharp ring formed by the connective tissue in the neck of the hernial sac.

A strangulated right inguinal, or femoral hernia, may be mistaken for an acute appendicitis. In three instances we have encountered a gangrenous appendix in a strangulated hernia, and many such cases have been reported.

We have encountered a preperitoneal inguinal hernia, strangulated for one week, containing 20 cm. of small intestine which was strangulated by the thickened peritoneal circular constricting band of the internal abdominal ring. The intestine after passing through this ring had passed between the transversalis fascia and the peritoneum instead of entering the inguinal canal. Here it became gangrenous and perforated without being discovered until the patient was brought into the hospital suffering from hopelessly advanced peritonitis.

A strangulated hernia so small as to be overlooked has been mistaken for every variety of mechanical obstruction of the bowels, but if a careful physical examination is made this is not likely to occur.

In almost every case in which an error in diagnosis is made in strangulated hernia this is due to the fact that the physical examination has not been sufficiently careful.

Etiology.

The strangulation is usually due to the fact that a small loop of intestine has been forced out into the hernial sac, which existed previously, by some unusual exertion, and that the connective tissue forming the neck of the sac has constricted the intestine at the point at which it issued from the abdominal cavity, and, interfering with the return circulation the portion of the intestine contained in the sac becomes congested and edematous. The drainage from the lumen of the intestine is obstructed at the same time, which favors the multiplication of micro-organisms contained in the intestinal contents. With the increasing edema the circulation is presently shut off entirely and the loop of intestine becomes gangrenous and perishes, becoming an excellent nourishing medium for the micro-organisms in its lumen.

In the meantime the complete intestinal obstruction has injured the portion of intestine above the constricting ring, because there is a certain amount of tension upon the mesenteric vessels interfering with the nutrition.

The pressure within the lumen of the intestines is greatly increased by the accumulation of gas within the bowel, due to the decomposition of the contents which cannot be expelled. Too often this pressure is increased to a marked extent by the administration of food and cathartics by mouth. Presently the distension of these intestines will be sufficient to permit transmission of micro-organisms contained in their lumen resulting in a direct infection of the peritoneal cavity. In the meantime again the infection from the gangrenous intestine within the hernial sac may result in a thrombosis of the mesenteric vessels in the intestine in the peritoneal cavity, causing an extension of the gangrene.

Treatment.

From the moment a patient with strangulated hernia comes under care we must absolutely prohibit the giving of food and cathartics by mouth, because this can only serve to increase the pressure within the intestine and may also serve to force infectious material through the intestinal wall.

If the patient comes under care within the first twenty-four hours it is usually safe to make quite a prolonged effort to reduce the hernia by means of manipulations, the patient lying upon his back with the lower end of the table or couch elevated to an angle of about 40°, with the knees drawn up in case of femoral or inguinal hernia, or with the patient lying flat on his back in case of umbilical or ventral hernia. But even in these cases which come under care early, we must be careful not to injure the intestine by using too much force. If the strangulation has existed much longer, still greater caution, as before mentioned, must be exercised. This is especially true of very small herniæ in which the intestine is often hopelessly destroyed even after thirty-six hours, in which case its return to the abdominal cavity would almost inevitably result in a diffuse peritonitis and death of the patient.

Failing in the reduction, an immediate operation is of course indicated, and this can usually be done directly after the attempt at reduction under anesthesia has been made, without permitting the patient again to gain consciousness.

If possible, it is always best in these patients to perform gastric lavage as described above. Aside from this nothing need be done beyond carefully scrubbing, shaving and disinfecting the field of operation and covering the remaining portions of the body with sterilized towels.

Operative Technique.

We will here speak of the three common forms of strangulated hernia, femoral, inguinal and umbilical, together, because the same principles apply to all alike.

An incision is made over the center of the swelling, the successive layers of tissue being elevated between two pairs of dissecting forceps in order to facilitate the work by protecting the underlying tissues. If the hernia has existed a considerable period of time the discolored intestine will shine through the hernial sac, which may be smooth and shining, or it may be roughened and adherent to the overlying tissues. This condition is especially likely to be present if the hernia has existed for a long time, and if a tightly-fitting truss has been worn.

Precautions.

If the layers are picked up with two pairs of forceps and the incision

made only through tissue thus elevated there is no danger of wounding the intestine within the hernial sac. Occasionally one encounters a thick layer of pre-peritoneal fat on the outer surface of the sac which looks so much like omentum that it is quite confusing. It is well to watch for the hernial fluid which can always be found in the sac in strangulated hernia. Frequently there is a sufficient quantity to protect the contents of the sac from injury in making the incision, but quite as often the quantity is very slight; still we believe it is always sufficient to indicate the fact that the sac has been opened.

There is, however, one source of error which has been observed in practice. Occasionally the bladder is drawn into the hernial sac and this has been opened and the urine which escaped has been mistaken for hernial fluid. In case of doubt in this direction it is well to introduce a steel sound into the bladder and examine this organ in the direction of the hernia. In case the accident has happened it is best to suture the wound in the bladder at once with a double row of Lembert sutures of catgut. It is necessary to observe three precautions in suturing such a wound in the bladder: 1. The stitches must be applied with great regularity in order to make the closure impermeable to water. 2. The stitches should not protrude into the cavity of the bladder, in order to prevent formation of stone. 3. They should be tied sufficiently loose to prevent pressure necrosis at any point.

After the hernial sac has been opened and the hernial fluid carefully sponged away, the intestine should be inspected. If this is covered by an uninjured, smooth, shining peritoneum it is likely that it will revive even though it may be quite black. It is not wise to attempt its reduction without enlarging the constricting ring at the neck of the hernial sac because the strangulated loop of intestine has already suffered so severely that it is injudicious to injure it further by unnecessary manipulations.

Cutting the Constricting Ring.

Many methods of cutting the constricting ring have been advised, but unless the operator has through experience acquired especial skill in the use of one of these methods we would advise him to make the incision through all the tissues sufficiently free to expose the edge of the constricting ring and then to introduce preferably a Kocher director between the intestine and the ring and then a scalpel or the blade of scissors between this and the ring, making an incision transversely across the constricting tissues. The strangulation is not usually caused by the tissues of the abdominal wall, but by a hard, inelastic, fibrous ring developed from the tissues composing the neck of the hernial sac.

In femoral hernia it is well to cut inward in order to cut away from the femoral vein. In inguinal hernia it is well to cut in the direction of the inguinal canal, first splitting the fibers of the fascia of the external oblique abdominal muscle, as described in the operation for radical cure of inguinal hernia. If it becomes necessary to cut the constricting band without having it exposed to sight, it is well to insert the finger into the canal in order to determine whether the epigastric artery is in the normal position. If it is it can be easily avoided; if it is not, it will be best to enlarge the external wound until the constricting portion is in view, when it can be cut safely over a director or over the finger which has been inserted between the intestine and the constricting ring. It is now pos-

sible to draw out a further portion of the intestine for inspection. If only one portion has been hopelessly destroyed by the pressure, this will be found just at the point where the intestine was grasped by the constricting ring. Frequently the dark color of the entire loop found in the hernial sac will begin to disappear after the ring has been cut and the circulation in that portion of the intestine becomes re-established.

Determining the Vitality of the Strangulated Gut.

Covering this portion with pads moistened with warm, normal salt solution for a minute or more the intestine appears more and more normal and when irritated by touching it the muscles respond by contracting. In such case it is safe to return the intestine into the abdominal cavity and so complete the operation as described under radical cure.

Even if there is no muscular contraction, but a satisfactory return of the circulation, it is safe to return the gut, provided the peritoneal covering is smooth and shining. If, however, there are areas of tissue upon the peritoneal surface which are roughened, or if portions show by their thinness that some of the deeper layers of the intestinal wall are actually necrotic, it becomes necessary to remove the gangrenous portion and to unite the two portions of intestine thus severed.

The upper branch of the intestine is always the one which has suffered most because the peristaltic pressure has forced intestinal contents down to the point of obstruction, consequently this portion of intestine is often greatly distended with gas and feces.

Resection of Gangrenous Portion.

Before cutting away the gangrenous portion of intestine it is necessary to provide against infection of the peritoneal cavity from its contents by carefully placing warm, moist pads of gauze about the loop. Two pairs of long-jawed compression forceps are applied half an inch apart, and two or three inches from the gangrenous intestine, upon the lower segment, which is ordinarily nearly normal, so as to close the lumen of the intestine completely, the points of the forceps reaching about half an inch beyond the mesenteric attachment of the intestine. An incision is made down to the mesentery between these two forceps, then the mesentery of the gangrenous portion of the intestine is transfixed and ligated with catgut. It is best to do this in several sections in order to prevent slipping of the stump.

The intestine is cut loose from its mesenteric attachment and if greatly distended above the gangrenous portion it is well to have the patient rolled over to the side of the operation, and after carefully applying moist gauze pads about the wound to place the end of the intestine which has been cut loose from its mesentery into a basin, to grasp the cut edge at different points with hemostatic forceps and then to remove the long-jawed forceps closing the end of the intestine. In this manner the loosened intestine will act as a tube through which the contents of the upper part may safely be emptied.

In order to obtain a safe point to unite the lower with the upper segment of the intestine it is necessary to sacrifice, in most cases, quite a long piece of the upper segment. It is a better plan to close both cut ends of the intestine and make an anastomosis between the lower segment near its end and the upper segment far enough from its end to be certain that the intestinal walls are quite normal. In this way quite as good a union

can be obtained as by resecting a large portion of the upper segment, and much time is saved in the operation, as well as much shock, because the amount of traumatism is very greatly decreased in this manner.

The portion of the upper segment of the intestine below the point of anastomosis remains perfectly harmless.

The methods of closing the ends of the severed intestine and making the anastomosis are fully described in the section on intestinal surgery.

Removal of Bowel Contents.

In other cases in which it is not necessary to make a resection of the bowel, the distended intestine should be emptied after the method of Marks. This consists in placing a purse-string stitch in the wall of the distended intestine making a circle about 1 cm. in diameter, the ends of the stitch remaining loose. An opening is now made in the center of the purse-string area and a glass tube about 2 cm. in diameter and about 30 cm. long is inserted into the intestine and the purse-string is now tied to prevent leakage around the tube. A large rubber tube is slipped onto the free end of the tube and its free end placed in a basin. The intestine is now gradually threaded onto this glass tube and as this is done the intestinal contents are all forced out through the glass tube. A loop of intestine at about the center of the distended intestines should be chosen as a point to insert the tube. The glass tube is first directed toward the upper end of the intestinal canal and this half emptied. The tube is then withdrawn until it can be directed down the lower half of the intestine which is now threaded on the tube, emptying this portion of the bowel. The tube is now removed and the opening in the intestine closed by tying the purse-string stitch and placing a Lembert stitch over it. This process removes a large amount of septic material from the alimentary canal and leaves the intestine in a collapsed condition.

After-Treatment.

After operation for strangulated hernia no food should be given by mouth for several days, and then only predigested substance and later broths, soups and milk. The patient may be nourished by enemata consisting of one ounce of some predigested food dissolved in three ounces of normal salt solution given every four hours. Cathartics should not be used until at least a week after the operation, and then only mild salines in small, often repeated doses. Small sips of very hot water may usually be given from the first.

The treatment of the wound must be left to the judgment of the operator. If it seems wise to close the wound this is done in the manner described in operations for radical cure, except in femoral hernia. In femoral hernia the defect made in the ring by cutting the constriction must be repaired in order to prevent the recurrence of the hernia. This can be accomplished very readily with a few interrupted, chromicized cat-gut stitches. In all other respects the same methods may be followed as in operation for radical cure.

If in any given case it seems unwise to close the hernial opening at once it is well to insert a glass or rubber drainage tube, covered with iodoform gauze, through the hernial opening down to the injured intestine. It has been our practice to withdraw this tube on the second or third day, and after that to withdraw the gauze gradually, by pulling upon it as much as seems wise each day. If the wound suppurates, it is to be treated like

an infected wound elsewhere. If it remains aseptic it may be closed by means of secondary sutures a week after the original operation.

This operation must frequently be performed in old and feeble patients, and these do not bear confinement in bed well. It is consequently wise to encourage their moving about in bed and sitting up early.

If a fecal fistula occurs it is well to continue the feeding by enema for two or three weeks, which will usually suffice for a spontaneous cure. If the fistula persists it may become necessary to make an abdominal section for its relief, the technique of which will be found under intestinal surgery.

If the patient seems too weak to bear the operation of anastomosis of the two portions of the intestine, or if the operator who performs the operation does not feel competent to conduct this part of the work, temporary relief may be given by drawing out the intestine for a distance of two or three inches through the enlarged hernial opening, placing strands of gauze between the intestine and the edges of the opening, ligating the mesentery of the gangrenous portion, cutting away the latter and leaving the ends of the intestine open for drainage and leaving the construction of an anastomosis for future consideration.

Important Points.

The points which should be impressed especially in connection with this subject are: 1. The necessity of always making a physical examination in cases suffering from intra-abdominal pain, nausea or vomiting, and always to examine for hernia in these cases because this will enable the physician to make an early diagnosis. 2. The necessity of relieving the strangulation at once. 3. The fact that these cases are more likely to recover if relieved of the strangulation early by a clean physician or surgeon with little or no experience, than by a surgeon with the greatest possible skill if operated late.

DIAPHRAGMATIC HERNIA.

Diaphragmatic hernias are very rare and when they do exist are seldom diagnosed before the abdomen is opened. The majority of cases that have been reported have been found post-mortem.

Diaphragmatic hernia may be congenital or acquired. The congenital variety is rarely amenable to surgical treatment, because so great a portion of the diaphragm is absent that it is impossible to close the large opening.

The acquired variety may frequently be benefited by operation. These herniæ may follow stab wounds, gunshot wounds and crushing injuries, or they may develop through one of the normal openings in the diaphragm from any cause producing an increased intra-abdominal pressure. The most frequent site for the hernia to take place is through the opening of the esophagus.

The symptoms of diaphragmatic hernia are most commonly those of strangulation of some of the abdominal viscera, but the real cause of the strangulation is rarely diagnosed until the abdomen is opened.

There can be no definite operation planned for the relief of these cases. There is a difference of opinion among surgeons as to the method

of approaching such a hernia. Some advise attacking it through the pleural cavity, while others prefer the abdominal route.

In many of these cases the stomach and nearly all of the intestines are found in the hernial cavity.

The very large hernias are hopeless as far as closure of the hernial opening is concerned. In two cases Mayo was able to close the hernial opening by suturing the wall of the stomach to the edges of opening in the diaphragm and to the abdominal wall and parietal peritoneum in several places. Both patients made a good recovery.

SPLENECTOMY.

This operation is indicated, aside from cases in which the spleen is the seat of a severe traumatism, only in patients in whom the size of the spleen is in itself a burden, and in whom medical treatment diligently applied has failed to relieve. It is contra-indicated in cases of splenic leukemia having a leucocytosis of more than 50,000 because these patients regularly die of shock or hemorrhage, while they frequently live in relative comfort for a considerable period of time if not operated.

History.

The patient exemplified is a school boy twelve years of age. He has lived in this city since birth, has never been strong, but until two years ago he had never been sick in bed. At that time he began to feel weak and languid and to lose in flesh and look badly. At the same time he noticed a small swelling in the left hypochondriac region. All of these conditions have slowly but constantly become worse notwithstanding constant treatment. He came under our observation two months ago, since which time he has been treated continuously. First he received tonics containing arsenic, then phosphorus; then he was given two grains of quinine in solution every two hours night and day for thirty doses, which was repeated after an interval of six days, in order to keep fresh quinine in his circulation constantly to counteract any malarial infection which might have escaped detection; the examination of the blood having failed to show the presence of the plasmodium of malaria. All of these forms of treatment had a negative result. The same was true of the use of iodide of potassium, which had been given experimentally some time before.

Present Condition.

Somewhat emaciated, anemic, tongue coated, appetite fair, bowels slightly constipated, pulse 70, lungs and kidneys normal. Examination of blood shows a count of 3,500,000 red and 6,000 white corpuscles. The lymph glands are nowhere enlarged. The abdomen is considerably more prominent on the left than on the right side. Palpation shows a tumor extending from a point one inch below the left costal arch to an inch above the anterior superior spine and a little beyond the middle line to the right. Pressing forward from behind the tumor moves toward the right side of the abdomen. Several deep notches can be felt in the relatively sharp edge on the right side. The tumor is not freely movable. It is slightly displaced by respiration.

Diagnosis.

The most characteristic feature in this case is the form of the tumor, being oblong from above downward with a sharp border on its right side and distinct notches in this border.

All of these characteristics would not be present in a tumor of the kidney or the descending colon, the only organs in which tumors occasionally develop in this vicinity, hence an enlarged spleen is the only probable diagnosis.

Indications for Treatment.

Internal treatment has been patiently and carefully employed for two years, and during the past two months under our observation. Had the spleen been enlarged because of a malarial infection the treatment with quinine and arsenic would have made an impression. The diagnosis of malaria seemed plausible because the child has lived near the north branch of the Chicago river in a vicinity infested with mosquitoes, which breed in the clay holes of an old brickyard containing stagnant water and refuse. It is true that the examination of the blood failed to discover the plasmodium, but this might be accounted for by the chronic condition, which makes it much more difficult to find the parasite. The tumor continues to increase in size and encroaches upon the other organs.

Were the proportion of white to red blood corpuscles greatly increased, indicating the presence of leukemia, an operation would be positively contra-indicated, because in that case either primary or secondary hemorrhage is sure to occur and the patient never survives the operation if this condition is at all advanced. It seems safe to place a leucocytosis of 50,000 as the upper limit of safety for the operation of splenectomy. Before operation these patients should receive a liberal diet of milk with the albumen of six to ten eggs daily, the latter best given in fruit juices in order to increase the palatability.

The blood must, of course, be examined repeatedly for the presence of the plasmodium malariae, because its presence would indicate the possibility of obtaining a reduction in the size of the spleen by the systematic use of quinine and arsenic. The former remedy should be given in solution in two-grain doses every two hours night and day for thirty doses, then one-fiftieth of a grain of arsenious acid should be given at intervals of three hours, six times daily, for six days, then the course of thirty two-grain doses of quinine should be repeated. This method insures the presence of fresh quinine in the body constantly and is much more effective in these chronic cases than when given in larger doses at longer intervals; indeed, many cases in which enormous doses of quinine given from two to four times a day had no permanent effect after treatment for weeks or months, have recovered after ten days' treatment by this method. We have had an opportunity of testing this method in a large number of cases of chronic tropical malaria and have found it absolutely reliable. It is well to give these patients two ounces of castor oil in the foam of malt or beer daily during this course of treatment in order to ensure perfect absorption of the remedies.

Operation.

The length of incision will depend upon the size of the tumor. It is most convenient to make it along the outer border of the left rectus abdominis muscle, or through the outer edge of this muscle. It should be quite long enough to permit of all the manipulations without crowding, because the safety of the operation depends largely upon the absence of traumatism.

It is important to loosen the peritoneal support of the spleen before the blood vessels are interfered with. First the phreno-splenic ligament is



PLATE LXIII

Showing vessels of spleen clamped by long forceps, jaws protected by rubber tubes.
(Mayo.)



grasped between two pair of large pressure forceps and cut between. The phrenic end is then carefully transfixed and ligated, the forceps on the splenic end being left in place. Then the peritoneal support not included in this structure is treated in the same manner.

If there are any inflammatory adhesions they are treated as in all other intra-abdominal operations. When the spleen has been made free slowly and carefully, without unnecessary traumatism, down to the hilus to which is attached the gastro-splenic omentum containing the important blood vessels, this is loosened above and below to form a pedicle, which may be grasped with a pair of heavy pressure forceps, or it may be transfixed with a blunt aneurysm needle and tied in halves with cat-gut, a second ligature being applied around the entire pedicle at a point one-eighth or one-fourth of an inch away. The pedicle is then cut beyond these ligatures and the separate branches of the splenic artery and vein may be tied once more separately. If the pressure forceps are applied instead of first ligating the pedicle, the pedicle may be cut a short distance beyond the forceps; then the vessels may be picked up at their ends and ligated separately, and then the ligature may be thrown around the pedicle just above the point at which the forceps were applied. The forceps are taken off while the ligature is being tied, which will permit the latter to slip into the groove made by the former.

Any raw surfaces which may remain are covered with peritoneum by means of cat-gut sutures.

In case there are areas which cannot be covered, from which there is a considerable amount of oozing, they should be tamponed with iodoform gauze, which should be permitted to protrude from the wound; otherwise the wound is closed in the usual manner, great care being taken to have each layer in accurate apposition.

In all cases in which the leucocytosis exceeds 20,000 it is well to make a drainage opening through the back and to carry one or two glass or rubber drainage tubes from the seat of operation through this opening. These may be removed after two or three days.

The after care of these patients is the same as following other abdominal sections.

WANDERING SPLEEN.

Occasionally a spleen will become extremely movable so that it may be dislocated to all parts of the abdominal cavity. This may be accompanied by a considerable amount of suffering in the form of acute pain and digestive disturbances.

In these cases the phreno-splenic ligament is drawn out so that it no longer serves as a support, and the other peritoneal support is equally useless. This pedicle may become twisted and may give rise to severe pain or even collapse. It may give rise to a diagnosis of acute mechanical obstruction of the intestines.

Operation.

The incision described in the previous operation is again employed, then the outer edge of the wound is retracted thoroughly and a pouch formed out of the parietal peritoneum and transversalis fascia sufficiently large to conveniently hold the spleen which is sutured in place. What is left of the phreno-splenic ligament is utilized in fastening the spleen in this position.

In performing this operation care should be taken not to do anything which might interfere with the blood vessels in the gastro-splenic omentum.

In case the pedicle has been twisted, or the operation just described does not promise permanent relief, it is best to remove the organ which can be done with the greatest ease in these cases by simply ligating the pedicle and cutting it off two cm. beyond the ligature.

These patients do not suffer from the loss of this organ.

The case whose history was given above has now been under observation for a period of twelve years. He has shown no ill-effects from his loss of spleen. Four years after the operation he had a severe pneumonia which took a normal course and during this attack examination of his blood showed the same conditions as in other cases suffering from pneumonia at the same time in the same hospital ward.

PANCREATITIS.

Since the surgeon has come to consider pancreatitis habitually with the same uniform system that he considers all other important intra-abdominal pathologic conditions, our appreciation of its importance, as well as our knowledge of this condition, has acquired reasonable dimensions.

Etiology.

Undoubtedly, the infection usually travels up the common duct into the gall-bladder where there is a possibility for the accumulation of a large quantity of infected bile mixed with mucus, which on its way down the common duct is easily diverted into the pancreatic duct if there is obstruction from gall-stones or edema below the point at which the duct of Wirsung empties into the common duct.

In our cases the irritation of the common duct has been due quite as often to the passage of infected sandy bile as to the presence of gall-stones.

There is much difference in the statistics of various authors regarding the relative frequency with which pancreatitis accompanies gall-stones. This is probably due to the fact that the diagnosis of pancreatitis is based on the impression the surgeon obtains from palpating the gland during operation, and one surgeon may consider the gland practically normal in an individual instance in which the same condition would impress another surgeon as representing a certain degree of enlargement.

Unless a surgeon has examined many cases in which the abdomen was opened for conditions which could have no relation with the pancreas, in order to become familiar with the feeling of a normal pancreas, it is not likely that his judgment in this matter can be entirely satisfactory.

It is therefore well to palpate the pancreas in cases of operation for the removal of uterine fibroids or ovarian cysts and other similar conditions. This can be done readily while the surgeon's hand is in the upper portion of the abdomen for the purpose of examining the gall-bladder.

All surgeons with large experience in this special direction seem to agree that pancreatitis patients almost invariably suffer from disease of the gall-bladder or ducts, and that gall-stones in the common duct are more commonly accompanied by pancreatitis than stones in the gall-bladder.

It has been suggested by Williams and Bush, and apparently confirmed by careful experimentation, that anatomic peculiarities interfering with the free drainage of pancreatic juice through the ducts of Santorini or Wirsung

provide favorable conditions for the infection of the pancreas. It is plain that when the natural conditions for free drainage of pancreatic juice are unfavorable, complete obstruction, due to the presence of gall-stones or edema, is much more likely to occur.

The colon bacillus is the most common cause of the infection, and is frequently associated with the streptococcus and the staphylococcus.

Pancreatitis, in common with all inflammatory diseases of the gall-bladder and ducts, frequently follows inflammatory diseases of the gastrointestinal tract.

After the pancreas has once been infected a species of vicious circle is developed from the fact that the swollen pancreas obstructs the portion of the common duct which passes through the head of this organ, which favors the development of septic micro-organisms above this point as well as their further backing up into the pancreas. It is for this reason that the free drainage due to cholecystostomy has given such uniformly favorable results.

All these facts seem to bear out the theory commonly accepted at the present time that, barring the rare occurrence of metastatic infection, pancreatitis is due to infection from the alimentary canal, usually through the biliary passages, or, according to Maugaret, more especially through the lymphatic system of these passages. The acute violent cases of hemorrhagic pancreatitis are apparently due to retrograde injection of the pancreas with infected bile and pancreatic juice which, according to Flexner, must be in a relatively concentrated form. In these cases which take a violent acute course there is commonly a rapid destruction of the gland parenchyma. In the chronic forms, on the other hand, the inflammation results in interlobular fibrous tissue hyperplasia. The secreting cells of the acini are more readily destroyed than the islands of Langerhans. This fact would account for the relative infrequency of glycosuria in mild or early cases of pancreatitis.

Diagnosis.

Until recently the diagnosis of pancreatitis was made incidentally only during the progress of operations on the gall-bladder or biliary tracts and the stomach. Since the attention of surgeons was generally directed to this condition by Mayo Robson, Riedel, Mayo and others, the diagnosis has frequently been made before, and confirmed during, the operation. From this it has become possible to associate the condition of pancreatitis with a number of more or less typical diagnostic signs observed before operation.

In 1904 Cammidge, in connection with the clinical work of Mayo Robson, brought out a most ingenious chemical test which promised to be of great value in the diagnosis of this condition.

The method has been described most clearly by Schroeder, as follows:

Forty c.c. of the urine, filtered, acid reaction, free from albumin and sugar, are boiled with 2 c.c. of strong hydrochloric acid for ten minutes. After partly cooling, 8.0 gm. of lead carbonate are gradually added. When the reaction is complete, the mixture is chilled, filtered and the excess of lead in solution removed by addition of 2 gm. of sodium sulphate bringing the mixture to a boil, chilling and filtering to 20 c.c. To this filtrate is now added a mixture of phenylhydrazin hydrochlorate 0.80 gm., sodium acetate 2.0 gm. and of 50 per cent. glacial acetic acid 1 c.c. and the whole is boiled on a sand-bath for ten minutes. The solution is then filtered while hot and set aside to crystallize. The precipitation of crystals, sometimes only in

microscopic quantities, of the characteristic formation of ozazones, makes a positive reaction.

In 1905 we had a large number of tests made at the Augustana Hospital laboratory on patients who were later operated on, so that the findings could be judged as to their reliability by the actual examination of the pancreas. These tests were carried out by Dr. J. L. Yates, then chief assistant, whose large experience as a carefully trained laboratory investigator fitted him particularly for this task. He had, moreover, assisted in the diagnosis, operation and after-treatment of a great number of cases belonging to this special group, so that he also possessed a large experience as a clinical surgeon.

These tests were extremely fascinating, but it seemed to us that it required too much of the personal element of the observer to make the method useful except in the hands of unusually skillful experts.

The fact that surgeons like Robson and Moynihan continue to trust this test is, however, sufficiently important to convince us that it contains real merit.

Symptoms.

If we add to the well-known symptoms of cholecystitis an area of tenderness from 5 to 10 cm., long, located to the right of the umbilicus over the middle of the right rectus abdominis muscle, in cases in which we can exclude a diagnosis of duodenal ulcer, we have the typical symptoms on which to make a diagnosis of pancreatitis.

In duodenal ulcers there are two symptoms usually present which are not symptoms of pancreatitis: (1) pain before meals when the stomach is empty, and (2) hyperchlorhydria with eructations.

In pancreatitis there is frequently referred pain to the mid-scapular or left scapular regions. In gastric ulcer the same pain is commonly present, but with this there is pain on deep pressure at a point half-way between the ensiform appendix of the sternum and the umbilicus.

There are, of course, cases in which two or more, or all of these, conditions are present in the same patient, and other cases in which it is possible only to determine the fact that one or more of these conditions are present, while a strict differential diagnosis may not be possible. In these cases, however, it is quite possible to determine the necessity of an exploratory incision, and, when the indications for this are not clear, then it is usually safe to keep the patient under dietetic treatment until further study has cleared up the diagnosis.

Solomon has pointed out the fact that in the presence of pancreatitis von Noorden's oatmeal diet gives rise to typical butter stools and that an abnormally large amount of lecithin is excreted. From 0.4 to 1.2 gm. is excreted in twenty-four hours when these patients are placed on an egg diet, while normal individuals excrete not to exceed 0.1 gm. under similar feeding.

According to Schlecht, Mueller's test is quite reliable. The patient is given a test meal which is followed after two hours by a calomel purge. A few drops of the stool are sterilized by heat, then placed on an agar plate containing Loeffler's serum. The plates are kept in an oven at 131 to 141° F. for twenty-four hours. If trypsin is present the serum shows pronounced depressions, if absent the surface is smooth. Lepine has made most interesting but very complicated experiments which he claims are valuable in the diagnosis of this condition.

In advanced cases there is usually marked emaciation, frequently with peculiar circumscribed areas of fat in roll-like masses on the front and sides of the chest and abdomen. There is usually marked anemia present, often approaching chlorosis with degeneration of the erythrocytes. Many of these patients suffer from obstinate constipation, while others have equally troublesome diarrhea.

Sugar is present in only a small proportion of these cases.

Treatment of Chronic Pancreatitis.

The treatment must consist primarily in relieving the irritation due to the backing up of infected bile by establishing free drainage which must be sufficiently permanent to permit complete restoration of gall-bladder and ducts as well as the pancreatic ducts. It is important to keep the intestines and stomach normal and free from irritation permanently by the use of proper diet and hygiene after these operations.

In case gall-stones or pancreas stones are present, these must be removed, whatever their location may be. In rare cases in which the common duct is permanently obstructed, cholecystenterostomy may be indicated.

It is probably best to make the anastomosis between the gall-bladder and duodenum where possible, and between the gall-bladder and jejunum through an opening in the transverse mesocolon where the duodenum cannot be safely reached. The suture method should be employed similar to the one used in posterior gastro-enterostomy.

Surgical Treatment of Chronic Pancreatitis.

In chronic pancreatitis the treatment originally practised and advised by Mayo Robson, consisting in the establishment of perfect drainage through a cholecystostomy opening, seems to be still the best. The edema of the common duct and the pressure and consequent obstruction due to the presence of an enlarged pancreas are thus relieved and with this the pancreas and the liver are simultaneously reduced to a normal size.

The portion of the gland that has been hopelessly destroyed is, of course, permanently lost, but the remaining portions are usually sufficient to perform the necessary physiologic functions if the patient is properly educated in the selection of food.

Acute Pancreatitis.

It is difficult to make a differential diagnosis in acute pancreatitis with any degree of certainty because there are several other violent acute conditions which are so similar in their symptoms that they can probably never be positively excluded. The conditions most likely to be confounded are (1) perforation of the posterior wall of the pyloric end of the stomach; (2) perforation or gangrene of the gall-bladder or duodenum.

Cases of severe acute pancreatitis have been diagnosed as acute intestinal obstruction, renal colic, ectopic gestation and, of course, appendicitis and gall-stone colic.

Symptoms.

In acute pancreatitis the pain is extremely severe in the right upper quadrant of the abdomen. There is intense shock; nausea and vomiting are usually present and the patient gives the impression of being at the verge of dissolution. The abdominal muscles are tense, although Moynihan found this symptom absent in some of his cases. There is usually a steady rise of the pulse from the onset.

In these cases there is usually a history pointing to gall-stone colic in previous milder attacks.

If a tumor be felt there is usually tympanitis on percussion over this surface because the gland is located behind the duodenum.

Cyanosis has been observed by Opie and others. Sugar is present in the urine in some cases. Egdahl gives a careful review of 107 cases in his study of the symptoms and diagnosis of acute pancreatitis which is well worth the careful consideration of the clinician.

Surgical Treatment of Acute Pancreatitis.

In mild cases of acute pancreatitis surgical treatment is not indicated. If the local irritation is removed by making gastric lavage and placing the patient on exclusively rectal alimentation, so that nothing passes through the duodenum for a time, the obstruction to drainage through the common duct will soon subside because of the disappearance of the local edema, and then the conditions will be favorable for recovery from acute pancreatitis.

The correctness of this view must be plain to every one who has operated on a large number of patients, suffering from acute gall-stone impaction in the common and cystic ducts, at various periods during these attacks. If an operation is performed during the attack the simple drainage of the gall-bladder has always, in our experience, sufficed to relieve the condition, except in cases in which there existed at the same time a severe acute cholangitis, in which there has been a mortality of about 30 per cent. A moderate degree of cholangitis will subside even if there is marked acute pancreatitis, provided the operation itself does not increase the infection.

It should be as simple as possible and no rough or unnecessary handling of the inflamed tissues should be employed.

Even in violent acute cases of pancreatitis a proportion of patients will recover if the abdomen is quickly opened and simple drainage introduced. Glass tubes covered with gauze, split rubber tubes or cigarette drains may be employed. The number of recoveries depends on the severity of the attack and the promptness with which drainage is supplied. Robson has had nearly 40 per cent of recoveries. Patients in whom the extravasation of pancreatic juice has caused fat necrosis are least likely to recover. We have seen several of these patients that have recovered without, and one with, operation and Mayo reports similar results.

Unless jaundice is present it is best to limit the operation to the location and drainage of circumscribed areas of infection or necrosis of the pancreas, to the control of hemorrhage by means of fine catgut sutures, and the free drainage of the entire area. This can best be done through a median or a high right rectus incision. It is important to go over the gland carefully, but it is quite as important not to traumatize the tissues unnecessarily. These patients have but a slight margin of possibility of recovery and this can easily be lost by unnecessary traumatism or prolonged exposure.

If jaundice is present simple drainage of the gall-bladder, with removal of loose gall-stones, is indicated, but it is best not to interfere with stones impacted in the ducts. We lost two patients needlessly before appreciating the folly of doing too much in these cases.

Conclusions.

In a general way the following conclusions seem proper:

1. A clinical diagnosis of chronic pancreatitis is usually possible before operation.

2. This condition is practically always a complication of gall-bladder or gall-duct disease, except when following metastatic infection.
3. It is usually curable by relieving the pathologic condition of the gall-bladder and ducts.
4. An operative diagnosis of acute pancreatitis can often be made.
5. Early operation greatly improves the prognosis.
6. It is important to reduce to a minimum the trauma in these cases.
7. The important factor in the treatment consists in the establishment of free drainage.

PANCREATIC CYSTS.

In cysts of the pancreas resulting from a total occlusion of the duct thereof, usually due to traumatism, the treatment consists in making an incision either in the median line or through the rectus abdominis muscle. The tumor will be found to be retro-peritoneal, because the pancreas is a retro-peritoneal organ. The surrounding organs are tamponed away by means of moist aseptic pads, then the cyst wall is exposed by making a slit in the peritoneum. The cyst is then tapped with a trocar, then opened and the remaining fluid sponged away with moist pads. Then the cavity of the cyst is tamponed lightly with iodoform gauze and the edges of the wound sutured to the parietal peritoneum and transversalis fascia in the upper angle of the wound. The remaining portion of the wound is closed in the usual manner.

The iodoform gauze is later gradually removed. If there is no secretion after this has been done no further drainage is instituted, but if secretion continues a drainage tube is inserted when the tampon has been removed and this is kept in place until the discharge subsides, which usually occurs in a relatively short time, the cyst becoming obliterated by the adhesion of its walls.

HEMORRHOIDS.

Those suffering from hemorrhoids usually give a history of long-continued, habitual constipation. The patient's occupation is usually sedentary and the diet complicated and unhygienic, hemorrhoids resulting from obstruction to the return circulation through the hemorrhoidal veins. This obstruction may be local, due to accumulations in the rectum, or to the presence of tumors in the pelvis. Pregnancy is a common cause, or it may be the result of obstruction in the hepatic circulation.

Diagnosis.

There is a history of suffering from a sensation of fullness in the region of the hemorrhoidal veins. This may be accompanied by occasional hemorrhages, which give temporary relief to such sensation. If the condition has existed for a prolonged time there is a protrusion of mucous membrane containing distended hemorrhoidal veins at each evacuation of the bowels. These masses may become replaced spontaneously, or may have to be returned mechanically. Upon digital examination soft oval masses will be felt, varying in number from one to six or eight, although there are usually not more than three or four. Some of these masses are usually larger than others. They sometimes acquire considerable size rather more than an inch in diameter. In many cases there is a constant secretion from these sur-

faces, giving rise, on account of its irritating character, to an eczema. After the hemorrhoids have existed for a time, the patients usually complain of a constant burning sensation in this region.

Treatment.

In many cases simply regulating the diet, securing a regular free evacuation of the bowels each day, and applying some soothing ointment or suppository, together with the use of Sitz, or shower baths, will result in relief. If, however, it has existed for a long time this will usually not suffice, and an operation will have to be employed in order to secure permanent relief.

The patient should be cautioned to eat only easily digestible food in very moderate quantity, to take a mild saline laxative every day for several days previous to undergoing operation, and on the day before operation he should be given two ounces of castor oil, followed the same evening, and the following morning, with large flushings of the colon. In this manner the alimentary canal can be quite thoroughly freed from material which might otherwise irritate the wound surfaces after the operation.

Operative Technique.

In our own experience the following operation has proved exceedingly satisfactory in almost every case. The patient being anesthetized and placed in the lithotomy position the sphincter ani muscles are very thoroughly dilated by introducing the thumbs beyond the internal sphincter and stretching very slowly, but very thoroughly. The slow progress of the stretching will prevent tearing the mucous membrane unnecessarily. The stretching should be continued until the sphincter remains lax after it has ceased. Each hemorrhoid is then caught with two pairs of hemostatic forceps placed in a straight line with the direction of the rectum, the outer one being from one to two centimeters, the second from two to four centimeters, from the margin of the anus. A clamp is then applied to the hemorrhoid beneath the attachment of these forceps, also in the direction of the rectum. If it is convenient a clamp which is protected on its lower side with some bad conductor of heat, such as ivory, bone or rubber, is to be preferred, otherwise an ordinary pair of long-jawed hemostatic forceps will serve the purpose very well. The surrounding tissues should be protected by placing underneath the forceps a piece of asbestos cloth, or if this cannot be procured, a piece of gauze folded half a dozen times upon itself and immersed in cold water may be placed underneath the clamp. A shield may be cut out of ordinary pasteboard and this may be immersed in corrosive sublimate solution for a moment before using. This is slipped between the clamp and the patient, producing a perfect protection against burning. The projecting portion of the hemorrhoid is then carefully seared by means of a cautery. It is preferable not to cut away the projecting portion, and to cauterize the small portion left beyond the forceps, because if the entire hemorrhoid is thoroughly baked with a cautery not too hot, there is never any danger of subsequent bleeding, which is not the case when the top of the hemorrhoid has been cut off first and the cautery applied later. Any cautery will serve the purpose, but the one which we have found of the greatest service consists in a simple, small-sized soldering iron, heated in a tinsmith's heater, in an ordinary gas flame, in a coal stove or over an alcohol lamp. It is much more economical than any of the gasoline or electric cauteries, it is never out of repair, and can be easily procured anywhere.

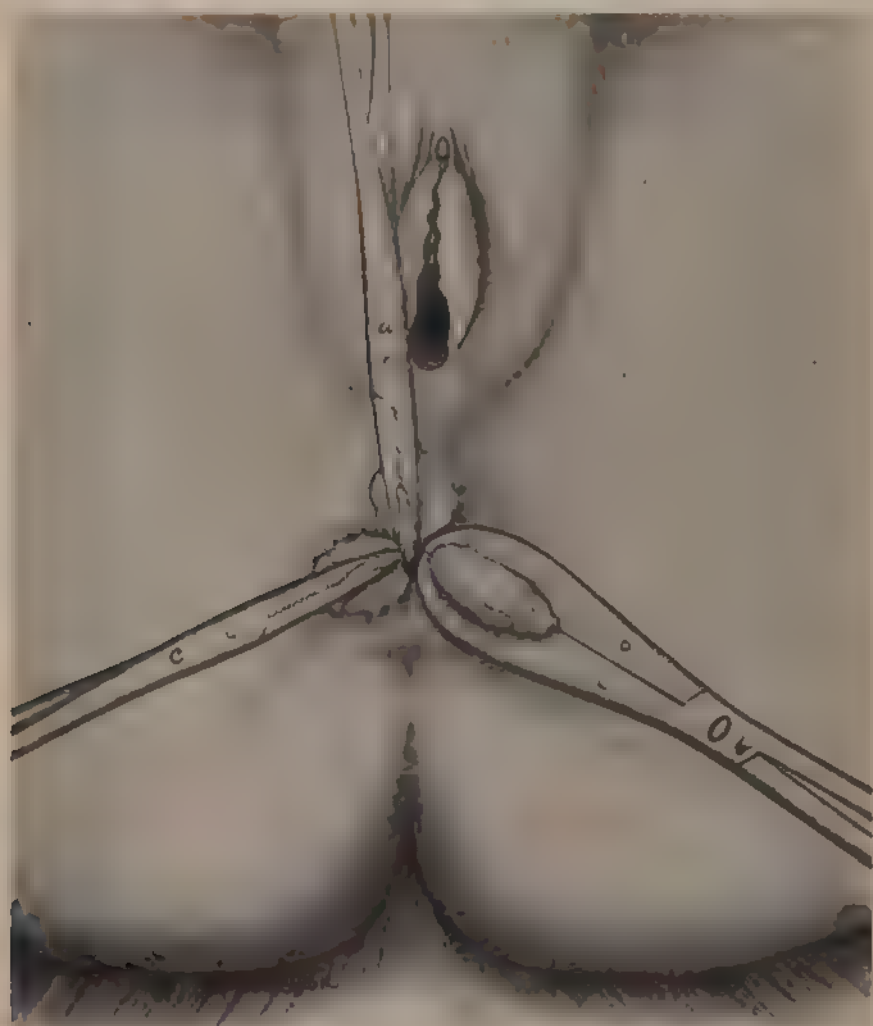


PLATE LXIV

CLAMP AND CANNULA OPERATION FOR HEMORRHOIDS

Showing forceps *a* and *c* in place for the purpose of marking hemorrhoidal tumors at beginning of operation. *b* clamp protecting underlying skin by means of ivory plates riveted to lower surface of jaw plates.



The successive hemorrhoids are then picked up in the same manner and treated alike.

The main vessels come down in three groups, one anteriorly and two laterally. If these are caught in three masses and cauterized, the remaining hemorrhoids will usually disappear spontaneously. It is important in applying the clamps always to leave at least half an inch of normal mucous membrane in order to avoid the production of stricture.

It is not wise to cauterize a hemorrhoid exactly in the median line in front, in a male, on account of its close proximity to the urethra, as it frequently happens, if this is done, that an obstruction to the passage of urine occurs for several days after the operation, which may prove exceedingly annoying; and if a hemorrhoid at some small distance to one side of the median line is caught the one which may exist exactly in the median line, and which may be larger than either of the others, will disappear spontaneously. It happens occasionally that there is but one hemorrhoid, and that this is just in the median line; then, of course, it will have to be clamped in order to secure relief. It is of very great importance that if the clamp and cautery method is used the clamp should always be applied parallel with the direction of the rectum, because if it is applied transversely the patient is almost certain to suffer from the formation of a stricture.

In selecting a clamp it is well to avoid an instrument with sharp serrations, as these would be likely to injure the delicate veins, giving rise to troublesome hemorrhage. Even with a properly constructed clamp care must be taken not to lacerate the veins.

Ligature Method.

If no clamp of any kind is available, and it is desirable to relieve a patient of hemorrhoids, this may be accomplished by the following plan, which we believe is quite as satisfactory as the clamp and cautery method, but we have not performed it nearly so often, having become accustomed to the other procedure.

The preparatory method and dilatation are the same as in the operation just described. The hemorrhoid is picked up in the same manner. It is then transfixed with a needle armed with double silk or cat-gut ligature, about thirty to forty centimeters in length. The needle is cut away and the ligature tied upwards underneath the second forceps. With scalpel or scissors the mucous membrane is then carefully cut transversely at the margin of the anus and the second ligature is tied in the groove thus formed. The projecting portion of the hemorrhoid is then cut away, only a sufficient amount being left to prevent slipping of the ligature. This method is applied to each hemorrhoid in succession until all have been removed.

Dressings.

The patient is much more comfortable, and the wound will heal quite as satisfactorily, if no dressing is applied after either the clamp and cautery or the ligature method. For a considerable time we habitually applied some form of tampon or drainage to the rectum after operating for hemorrhoids. This was decreased in amount constantly with increasing comfort to the patient, until at last we discarded this form of dressing entirely, and latterly for a large number of these cases no dressing has been used, except a little ordinary pad to the external parts held in place by a T bandage, for the purpose of absorbing any secretion.

After-treatment.

The patient is kept on liquid diet for four or five days. At the end of this time a cathartic is given and before this causes an evacuation a large soap and water enema is administered through a soft rubber catheter. This is repeated after the cathartic has acted. From this time on a small saline laxative is given every morning, and the evacuation is followed by the soap and water enema. The patient is confined to his bed for about a week.

In unusually severe cases the excision of the entire rim of hemorrhoidal tumors may be practised, although this is but very rarely necessary. Even in very extensive cases the results, after the application of the clamp and cauterization to three or four of the largest hemorrhoids, are very satisfactory, the others disappearing shortly after the operation. In case, however, it seems desirable to choose a still more thorough operation the following will bring a satisfactory outcome.

Radical Operation.

An incision is made at the margin of the anus and the mucous membrane, together with the enlarged hemorrhoidal veins, dissected out carefully for a distance of two to four centimeters. The mucous membrane is then drawn down from above and about eight interrupted cat-gut sutures are applied at regular intervals, reaching through all the coats of the intestine down to the mucous membrane, but not through it, and through the subcutaneous connective tissue at the margin of the anus. These sutures should be so applied that after the portion of the rectum containing the hemorrhoids has been cut away there will be still a slight projection of the mucous membrane of the rectum beyond the margin of the anus. All bleeding points are caught during the operation and carefully ligated with fine cat-gut. After the intestine has been sutured in place in this manner the projecting portion is cut away and the mucous membrane of the intestine sutured accurately to the skin, the normal portion projecting a little beyond the margin of the latter. If the eight stay sutures which were first applied are carefully placed their pressure will control the hemorrhage from the hemorrhoidal veins, so there will be no bleeding when the projecting portion is cut away.

The treatment after this operation is the same as after the operations which have been just described.

This last operation is very attractive, but in the vast majority of cases it is unnecessary.

Prognosis.

It does not matter which operation is chosen, the prognosis will largely depend upon the hygienic conditions the patient provides for himself. If proper food is taken, if constipation is avoided, and if proper exercise is enjoyed, the patient will remain permanently cured, which is not likely if these conditions are neglected.

FISSURE IN ANO.

One of the most painful affections, and which frequently accompanies the presence of hemorrhoids, or is secondary to the latter, is fissure in ano, which is a small lesion extending parallel with the rectum, and consequently at right angles with the sphincter ani muscles. It is this last fact which causes this condition to resist treatment, as the wound constantly gives rise

to spasmodic contractions of the sphincter ani muscles, and these in turn crush the surface which is already sore. The evacuation of the bowels is likely to open the wound, which may have begun to heal during the interval, and the accompanying pain gives rise to spasmodic contraction of the sphincter muscles; consequently the patient suffers severely for some time after the bowels have been evacuated. The application of remedies is of very little benefit, for the reasons just mentioned. Unless the condition is but very slight an operation must usually be resorted to before the patient can be properly and completely relieved.

Technique.

The operation in moderate cases consists simply in thoroughly dilating the sphincter ani muscles so that the wound may remain at rest for a few days. At the end of this time it will have healed spontaneously. If, however, the fissure has existed for a number of months, or years, the amount of cicatricial tissue formed along its course may be considerable, and then the simple operation of stretching the sphincter ani muscle may no longer suffice to give relief. In such case the muscles should be stretched very thoroughly, and then the cicatricial tissue excised and the mucous membrane brought down from above and attached to the wound at the margin of the anus with a few fine cat-gut sutures. This simple method has, in our experience, resulted in the relief of even very severe cases which had existed for a long time.

The after-treatment is the same as in operation for hemorrhoids.

FISTULA IN ANO.

It is but rarely that one suffering from fistula in ano comes under the care of a surgeon during the early part of his disease. He has usually suffered for months, or years, and has made use of various local remedies without benefit.

History.

The patient gives a history of having suffered from an acute infection in the ischio-rectal fossa, which resulted in an abscess, variable in size, opening spontaneously or by an incision. Before the occurrence of this infection there is generally a history of hemorrhoids. There has usually been a discharge of pus from the opening for a considerable time, during which the patient is fairly free from pain. Then the opening would close and there would be a reaccumulation of pus within the abscess, again provoking much suffering. These events may have existed for a greater or less extent of time, and there may have been a variable number of reaccumulations of pus. There may be one or a number of external openings. Quite a considerable proportion of these cases give a history of cough, and upon examination some evidence of pulmonary tuberculosis may be established.

The usual practice of introducing a probe into one of these fistulæ is, we believe, to be condemned, because it gives rise to an amount of pain, it may produce a new infection, and it does not afford the surgeon any information which he cannot obtain by simply looking at the external surface, and by making a digital examination.

Technique.

The treatment should invariably be surgical, although long-continued

applications, curettements and irrigations may, in very rare cases, result in a cure of the rectal fistula; still these cases are so rare that it is much better to invariably proceed to the radical surgical treatment as soon as the consent of the patient can be obtained.

The preparatory treatment should be the same as that described for hemorrhoid operation. The patient is anesthetized and the sphincter ani muscles dilated. Then a grooved director is inserted into the fistula from without and the finger within the rectum feels for a little projection in the form of a granulation, readily found in quite a large proportion. By carefully manipulating the grooved director it will find its way along the fistula to a point opposite this granulation, through which it can be pushed into the rectum. Then an incision is made directly through all of the tissues between the grooved director and the rectum. Sharp retractors are placed in the edges of the wound and the granulations carefully curetted away. If the surgeon looks for prolongations of the fistula, even these, too, in case they exist, end in a little granulation tissue projecting into the sinus which has been curetted. By looking for this little granulation one can feel all the various sinuses, and by laying them open freely and curetting away the granulation tissue, obtain a perfectly clean wound. If the fistulae have

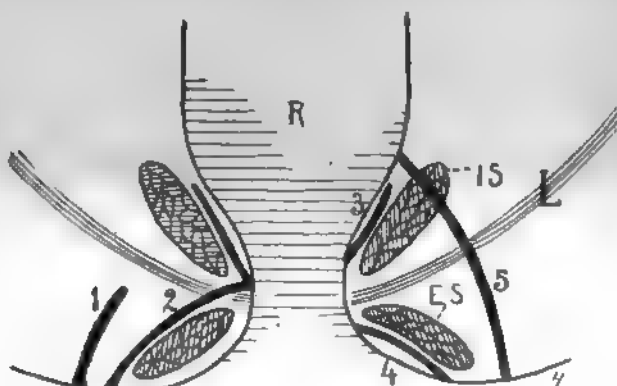


FIG. 19.

1. Blind external fistula. 2. Complete fistula 3. Blind internal fistula.

burrowed through the tissues beyond the sphincter ani muscles in various places the latter should not be severed except at the point of the first incision, for fear of having the patient lose control over the action of the bowels and the passage of gas. In case the fistula has existed for a long time the cicatricial tissue formed should be dissected away with a sharp scalpel, in order to leave the surface perfectly free and to have all portions of the wound as clean-cut surfaces. If all of the infected tissue has been removed, the course to be followed may consist in tamponing the raw surface with iodoform gauze, to be left in place for a number of days, and then replaced daily after evacuation of the bowels, or the surface may be closed by suturing. The latter method should only be chosen when the surgeon is absolutely certain that all portions of the infected tissue have been thoroughly removed. Then deep, silk-worm gut sutures may be inserted so they are buried throughout their entire extent, entering the tissues

at a point half an inch from the edge of the original wound, passing entirely around the area of the wound and issuing on the opposite side half an inch from the edge of the original incision. The mucous membrane of the rectum may be sutured separately with a row of cat-gut sutures, the silkworm sutures remaining untied in the meantime. If the sphincter ani muscles have been cut a few cat-gut sutures may be passed through them and tied separately. Then the deep silk-worm gut sutures are tied over all and a few coaptation stitches applied to the skin. This method will succeed in healing most of the simple fistulæ within ten days or two weeks; at the end of which time the deep silk-worm gut sutures are removed.

After-treatment.

The after-treatment is the same as in operation for hemorrhoids. If, however, the wound has not been closed with sutures an enema should be given after each evacuation of the bowels, and then the iodoform gauze tampon again applied to the wound, in order to compel the latter to heal from the bottom.

PROLAPSE OF THE RECTUM.

This occurs more frequently in childhood than during any other period. It is usually the result of straining due to constipation, or on account of phimosis in young children, or because of the presence of a fissure, giving rise to tenesmus. The mucous membrane of the rectum usually prolapses during the evacuation of the bowel and it becomes difficult and painful to replace it.

Technique.

If one of the causes mentioned still exists, it should be relieved and the condition treated in a non-surgical way at first. The patient should be placed in the inverted position and gentle pressure made upon the prolapsed portion, and a suppository composed of cocoa butter, some mild antiseptic substance, and some astringent substance, should be inserted into the bowel. The lower end of the child's bed should be elevated so as to add the benefit of gravitation to the treatment. If this form of treatment does not succeed in relieving the child, he should be anesthetized, the sphincter ani muscles very gently dilated, and then the treatment with clamp and cautery, described under the head of hemorrhoids, should be employed, with the exception that only a very small depth of tissue should be caught by the clamp, and also that the eschar extend a distance of three or four centimeters along the lower end of the bowel. Three, or at least four, longitudinal eschars will almost always suffice to relieve a prolapse in children. Of course, the same care should be exercised to have the eschars extend parallel with the bowel, insisted upon in connection with the clamp and cautery operation for hemorrhoids.

In Severe Forms.

In the adult prolapse frequently follows the long-continued existence of hemorrhoids, and usually the relief of the latter will result in the relief of the prolapse. In rare instances it happens, however, that neither of the operations described for the relief of hemorrhoids could promise any relief in this condition because the entire wall of the intestine may have prolapsed through the anus for a distance of a number of inches. In this event the prolapse should be reduced, after the preparations described in connection

with hemorrhoid operations have been carried out. The patient should be placed in bed, with the foot of the bed elevated from six to ten inches. This position is kept for a variable period, depending upon the severity of the prolapse—from one or two days to as many weeks—in order to disperse the edema which may exist in the intestine. Then an abdominal section is made through the median line and the lower end of the sigmoid flexure is found and carried to the left side of the abdominal cavity and stitched by means of a considerable number of fine silk sutures directly to the abdominal wall a little in front of its normal location. In this manner the entire rectum and the lower end of the sigmoid flexure will be carried upwards sufficiently to prevent recurrence of the prolapse. The sphincter ani muscles should be very thoroughly stretched so as to prevent any obstruction to the passage of gas and feces until the intestine has become firmly united with the parietal peritoneum.

If the sigmoid is drawn upwards, when the abdomen is opened with the patient lying in the Trendelenburg position, the prolapsing peritoneal pouch can be seen and obliterated with interrupted silk sutures, which will give the rectum a very substantial support.

It is important that a non-absorbable suture be used, because if the intestine is sutured with ordinary cat-gut the adhesions will be likely to absorb and the patient suffer from a recurrence, while if silk or chromicized cat-gut is employed this cannot occur. The bowels should be carefully regulated after this operation, so that there never is too great an accumulation in the large intestine.

All other causes of intra-abdominal pressure should also be overcome. If there is an obstruction to the passage of urine due to the presence of a stricture or enlargement of the prostate gland, it should be relieved. If the patient is suffering from a great accumulation of fat in the omentum, mesentery and abdominal walls, it should be relieved by proper diet and exercise. If all of these precautions are carried out a recurrence is not likely.

CARCINOMA OF THE RECTUM.

Patients suffering from carcinoma of the rectum usually give a history of long-continued irregularity in the evacuation of the bowels. At first there is usually long continued constipation; then this is interrupted by occasional attacks of diarrhea; then a history of the evacuation of ribbon-like formations of feces, indicating some constriction in the rectum, and later on there is usually complete temporary obstruction which may exist for only a short time at first and may recur at various intervals, or the patient may come under the observation of the surgeon during the first one of these attacks of obstruction. In most cases there is a passage of thick mucus, either with the bowel evacuation or during the interval between evacuations. In many cases there is also a slight amount of hemorrhage, and very rarely one of these patients suffers from a severe hemorrhage from the rectum.

Upon examination a hard, nodular mass is felt in the rectum, usually with a small central opening, or the mass may be upon one side of the rectum and on the other the mucous membrane may be normal. The sensation to the touch of a carcinoma of the rectum is so characteristic that if a surgeon has once experienced it he will have no difficulty thereafter in its recognition. It differs from the feeling of a stricture because of the nodular character, and because of the tumor-like projection of the mass, while a

cicatricial stricture simply presents the sensation of a narrowing of the canal. It differs from a tubercular stricture from the fact that although the latter also is nodular in character it does not give the impression of a tumor-like projection.

Technique.

If the carcinoma is in the lowest portion of the rectum, does not extend above the cul-de-sac of Douglas, and is movable, the treatment should consist in the excision of the entire mass, together with the surrounding tissues to as great an extent as possible. The incision through the skin should be free, should pass up behind to the lower edge of the sacrum, should include the coccyx, and the entire mass should be loosened from its attachment in one piece, so as to avoid the implantation of carcinomatous tissue during the operation. The rectum should be freed for a distance of at least two inches beyond the upper margin of the carcinoma, two pairs of strong forceps should be applied to the bowel at this point, and the latter severed between these forceps and the tumor thus removed. The bleeding vessels should be caught during the operation, so that the loss of blood will be reduced to a minimum, and from time to time all of these vessels thus caught should be ligated so as to leave the field of operation as free from obstruction, on account of the presence of hemostatic forceps, as possible. The upper segment of the intestine should then be freed sufficiently so that it can be brought into the upper angle of the wound and carefully sutured to the skin.

We have never encountered a carcinoma of the rectum in which it seemed safe to preserve the sphincter ani muscles. In a few cases in which we have attempted to remove the malignant growth and to attach the upper segment of the intestine to the lower segment, thus preserving the sphincter ani muscles, there has been a recurrence, but in the vast majority of cases the fact that a recurrence would follow was so plain at the time of the operation that the preservation of the sphincter ani muscles was not undertaken.

If carcinoma of the rectum is so far advanced that a rapid recurrence would be inevitable in case of its excision, which can usually be predicted when the tumor is removed, then we believe it is much wiser simply to do an inguinal colostomy, already described in the section on abdominal surgery.

In case the carcinoma is in the upper portion of the rectum, or in the lower portion of the sigmoid flexure, then the operation described under the head of abdominal surgery should be performed. In the female it often occurs that the carcinoma is upon the anterior surface of the rectal wall and has attacked the recto-vaginal septum; then the posterior vaginal wall should be removed, together with the entire rectum, after the method above described.

The after-treatment is the same as in operations for hemorrhoids, with the exception that the wound should be dressed daily in order to prevent its infection.

Prognosis.

Where the carcinoma has not perforated any portion of the intestine, the prognosis is relatively good, provided the amount of tissue removed is quite as extensive as though the case were advanced in its development. In advanced cases the prognosis is not good, without regard to the operation chosen. In our experience the cases in which permanent inguinal colostomy

was made prior to the excision of the carcinoma have lived longer than those in which the feces were permitted to pass through the rectum after the excision of the growth.

If it seems possible to secure a radical removal of the carcinoma by including a portion of the vaginal wall the following steps should be taken in the operation. Long, narrow retractors are introduced to each side into the vagina in order to expose its posterior wall freely, then an elliptical incision is made to include the entire posterior vaginal wall. The bleeding vessels are carefully caught and ligated and the incision carried backward on each side and around the anus a distance of at least 4 cm. from the anal orifice. The two incisions will meet opposite the tip of the coccyx. From this point a median incision is carried upward to a point 3 cm. above the lower end of the sacrum. At this point the wound is held open by means of retractors and the coccyx separated from its attachment to the sacrum by means of a chisel. This bone is left attached to the rectum, with which it is removed. It is not uncommon to find just in front of the coccyx, or in front of the sacrum, one or more infected lymph glands, and great care should be exercised in removing the tissues at this point. The entire tumor, together with the surrounding tissues, is now dissected out, care being taken to grasp the bleeding vessels as soon as they are severed, especially the branches of the internal pudic artery and the hemorrhoidal veins, in order to reduce the shock from hemorrhage to a minimum. This leaves the entire mass dissected out and only attached above to the healthy intestine.

The intestine is then at once grasped by two pair of hemostatic forceps at least 4 cm. above the upper margin of the tumor. By cutting the intestine between these the tumor can be removed without danger of soiling the wound. The upper segment is now carefully loosened so it can be brought down without tension. It is important to clamp the tissues, in doing this, before they are severed, with the hemostatic forceps in order to prevent dangerous hemorrhage. These tissues are carefully ligated after the intestine has been thoroughly loosened. Then the intestine is brought down and sutured to the posterior margin of the incision. It is important to carry the intestine at least 3 cm. beyond the margin of the skin because if this precaution is not taken it is almost certain to retract, and if it retracts within the margin of the skin a stricture is sure to occur. Here, as in all cases in which a tubular stricture is brought to the surface, it is best to apply a number of sutures several cm. back from the outer surface for the purpose of attaching the intestine to the wound surface, through which it is carried. Retraction of the intestine is much less likely to occur if this precaution is taken. Aside from this it is well to apply at least four sutures 2 cm. from the margin of the intestine to the skin, and the same number directly between the margin and the skin.

THE COMBINED ABDOMINAL AND PERINEAL METHOD OF REMOVING CARCINOMA OF THE RECTUM.

Where the carcinoma of the rectum extends upward too far to be completely removable from below, it is well to begin the operation after the method just described, loosening the rectum from below together with the tumor, removing the lymph nodes and fat and thoroughly controlling the hemorrhage. Then the entire space should be thoroughly tamponed with gauze and covered with sterile towels.

The patient is then placed in the exaggerated Trendelenburg position and a large median abdominal incision made extending from the pubis to the umbilicus. The sigmoid is brought into the wound and the point determined sufficiently far above the tumor to prevent recurrence. Two clamps are applied at this point and the sigmoid cut between them.

The upper end is covered with gauze and the lower segment carefully dissected out by applying forceps successively to the vessels entering the intestine.

This dissection is carried on until the portions of the sigmoid and rectum have been completely dissected out, when this will be removed together with the tumor. All of the fat and the lymph nodes are then dissected out with gauze dissection, then all of the vessels are ligated, the wound is drained downward with cigarette and gauze drainage and the entire surface covered with peritoneum.

The upper segment of the sigmoid is then passed through the abdominal wall, according to the method described under inguinal colostomy, and the abdominal wall is closed.

If the tumor is fairly circumscribed, the prognosis is good after this operation.

TUMORS OF THE ABDOMINAL WALL.

Lipoma.

Fatty tumors are occasionally found in the abdominal walls and can be removed without danger by simply making an incision down to the growth, enucleating it, and closing the wound in the skin.

Fibro-sarcoma.

Fibro-sarcomata frequently occur in the abdominal walls, taking their origin from any one of the various fasciæ; hence their name, *desmoids*. These tumors usually follow severe straining during labor and most commonly occupy the lower end of the abdominal muscles.

They should be removed freely, a considerable amount of the surrounding tissue being sacrificed. This usually involves one or more of the important muscles of the abdominal wall which must be replaced by a plastic operation consisting in the splitting of other portions of the abdominal wall and overlapping. Fortunately these tumors are relatively not very malignant, and a number have been permanently cured by removal. It is usually well for patients to wear some form of abdominal supporter after recovering from this operation.

ABSCESSSES IN THE ABDOMINAL WALL.

Abscesses in the abdominal wall sometimes follow traumatism, but more frequently result from an infection within the peritoneal cavity which has perforated a portion of the abdominal wall, from infections of the ribs which have burrowed downward, from empyemata of the chest which have burrowed downward, or from tubercular abscesses of the spine which have followed some portion of the transversalis fascia. The intra-peritoneal origin of these abscesses is most commonly the vermiform appendix, Fallopian tube, gall bladder, stomach, kidney, or urinary bladder. Foreign bodies, such as needles, nails or sharp bones, may penetrate any portions of the ali-

mentary canal and through adhesions of these to the abdominal wall, penetrate the latter and give rise to abscesses.

Treatment.

If the abscess is not tuberculous in character it is best to lay it widely open, curette away all granulation tissues carefully, and by looking for small areas in which granular tissue persists, one can usually follow the abscess to the point from which the infection originated. If this can be done and the cause removed with safety, it is well. If the origin of the infection cannot be found it is best to tampon the abscess cavity widely open and at the future dressings look for the source of infection, which can be determined from the fact that at some point there will be a new accumulation of pus. Often during the original operation the source of infection may be determined by making pressure upon the surrounding portions of the abdominal wall and watching for some point from which pus shows upon such pressure.

Thoroughness in exploration is the foundation of success in operation for the relief of this condition. If it does not seem safe to follow the infection to its point of origin at the first operation, it is often best to tampon the abscess cavity and later approach the condition from the abdominal cavity through a new incision, the location of infection having been determined by the primary operation.

INFECTION OF THE UMBILICUS.

Frequently in infants, and occasionally in the adult, infection of the umbilicus occurs, which may result simply in a slight superficial ulcer characterized by a tendency to remain open, or it may be deep-seated forming an abscess of the abdominal wall which may vary in depth, occasionally extending down to the peritoneum.

Treatment.

In superficial infections simple disinfection, the application of antiseptic dressings, and keeping the surface clean, will result in healing. In deep-seated infections it is important to curette away all of the infected tissue down to the deepest portion of the infected part, to disinfect the surface and tampon and permit healing to take place from the bottom. In either case the patient should be kept at rest.

Occasionally such an infection depends upon a remnant of the omphalo-mesenteric duct which should have been obliterated before the birth of the child. In such cases the mucous membrane lining this embryonic structure must be entirely removed in order to secure a permanent cure, because any remnant will be sure to be the cause of a new abscess as soon as the tissues have healed over this area.

In many of these the duct is continuous with the lumen of the small intestine. Then it is necessary to perform an abdominal section, excise the entire umbilicus, determine its point of attachment to the intestine and treat this attachment precisely after the manner of removing the appendix from the cecum, especial care being taken not to narrow the lumen of the small intestine at the point of removal of this remnant of the duct.

PART VI.

SURGERY OF THE ESOPHAGUS AND STOMACH.

SURGERY OF THE ESOPHAGUS.

Surgery of the esophagus in comparison with surgery of the rest of the gastro-intestinal tract is limited and probably will always remain so on account of the nature and position of the part.

In many conditions the treatment is of a palliative character. The distress from interference with the function of the esophagus is so great that these palliative measures seem worth while.

Methods of Examination.

The most common method is the passing of bougies. In sounding the esophagus it is important to remember that under normal conditions the canal possesses four constrictions. It is also important to know the total length of the tract and the distance of its most important portion from the teeth. The esophagus is ten inches in length. It begins six inches from the incisor teeth and passes through the diaphragm sixteen inches from the teeth. It is crossed by the arch of the aorta ten inches from the teeth.

The examination with a bougie should be conducted very carefully and slowly, for in this way only is it possible to follow the course of the tube without injury, especially when it is in a diseased condition.

Two kinds of bougies may be used for sounding the esophagus, the English bougies or the olive-tipped bougies. The former are constructed of a woven material, impregnated with a gummy material, and may be softened or hardened by placing them in warm or cold water, respectively. In this manner they may be bent into any desired shape. The olive-pointed bougies consist of a flexible hard rubber staff, on the point of which is placed an olive-shaped tip of hard rubber or ivory.

When a stricture is present it is easier to determine its location by means of the olive-tipped than by the English bougie.

Before sounding an esophagus, artificial teeth should be removed and the patient examined for aneurysm of the aorta. The passing of bougies in cases of aortic aneurysm has been known to cause death from hemorrhage.

Patients who are being examined for the first time are apt to gag, making the procedure very unpleasant. This may be overcome to a great extent by first spraying the pharynx with a four per cent solution of cocaine, allowing the patient to swallow a little of same, then waiting five minutes before passing the sounds. The bougies are passed with the patient in a sitting posture, with the head erect or bent a little forward; then the operator places the index finger of his left hand on the base of the

tongue, pressing downward and forward, while the bougie is passed by the right hand along the posterior wall of the pharynx to the beginning of the esophagus. The patient is now told to swallow and the sound will pass on into the esophagus.

A half-inch bougie should easily pass through every portion of the esophagus. Its failure so to pass is a sign of stricture. A three-fourths-inch bougie is as large as should ever be used in dilating a stricture.

Occasionally in passing a bougie one meets with an apparent obstruction. In these cases it is sufficient under normal conditions to withdraw the bougie a short distance and then advance it again, or the obstruction may be overcome by asking the patient to swallow or to bend the head a little forward.

Esophagoscopy.

Esophagoscopy cannot be considered an important aid in diagnosis. Little is to be determined by this means that cannot be ascertained by the more simple methods of examination. The simplest and safest form of esophagoscopy is by the straight tube, the light being thrown into this by either a Leiter panelectroscope or a Casper electroscope. Numerous devices for esophagoscopy have been invented during the past few years, but not much evidence of value has accumulated from their use. Esophagoscopy should only be attempted by those who have had special training along this line of work.

Radioscopy.

Radioscopy is frequently a valuable aid in the diagnosis of esophageal lesions, especially in the location of foreign bodies. It may also be considered in connection with the diagnosis of strictures, dilatation and diverticula.

A rather definite outline of the esophagus may be obtained by an X-ray photograph by administering a large quantity of bismuth, mixed with some starchy food, just before the picture is taken.

Percussion.

Percussion is of minor importance in the diagnosis of lesions of the esophagus. In case of diverticulum in the neck, if the latter is filled with gas, percussion will give a tympanitic note; if filled with food, a dull note. Occasionally in the presence of a growth in the esophagus one is able to determine a dull area corresponding to the location of the tumor.

INFLAMMATORY PROCESSES OF THE ESOPHAGUS.

Acute catarrhal inflammation of the esophagus may result from the irritation caused by foreign bodies, from a mild scalding, or from swallowing some chemical causing an irritation but not strong enough to cauterize. It is characterized by the secretion of mucoid material. Where the inflammation is more severe, it may result in superficial erosion or ulcers, but these usually heal without any serious consequences.

Chronic catarrhal inflammation of the esophagus occurs in chronic alcoholics, also in cases of stenosis of the esophagus from various causes, and from the accumulation of food in a dilated portion above a stricture. These cases usually recover without any complications by relieving the cause of the inflammation.

TOXIC ESOPHAGITIS.

Toxic or corrosive esophagitis occurs after the ingestion of some chemic caustic substance, or a scalding fluid may act in the same manner. From a surgical standpoint toxic esophagitis is the most important inflammation of the esophagus, because of the complications which are apt to follow, especially the formation of strictures. In cases where the injury is only superficial, the epithelial layer may be thrown off without any complications following. Where the erosion is deep, causing a slough of the entire thickness of the mucosa, and perhaps some of the muscular coat, the inflammation may extend beyond the esophagus, forming a peri-esophageal abscess extending into the mediastinum. The eroded area undergoes cicatrization after the slough is thrown off and as a result of the contraction of this scar a stricture is apt to follow. Swallowing of a large amount of the concentrated alkalies or acids is apt to end fatally on account of the slough it usually causes in the stomach.

The authors recently had a case of a woman who tried to commit suicide by swallowing one ounce of strong hydrochloric acid. The patient was remarkably free from esophageal symptoms, but nine days after the ingestion of the acid she vomited a large roll of tissue, which proved to be a considerable portion of the mucous lining of the stomach. The tissue was in one piece, was somewhat gangrenous in appearance and measured fifty square inches. The patient was kept on liquid food and had no symptom referable to the esophagus, but complained some of a burning pain in the stomach. After about four weeks she began to lose in weight rapidly and every second or third day would vomit a large amount of dark fluid. We first saw the patient twelve weeks after the swallowing of the acid. At this time she complained of a large swelling in the abdomen, which she said seemed like a large sac of water. The patient was greatly emaciated and on examination there was a soft mass extending from the epigastrium to the symphysis pubis. A distinct splashing sound could be elicited and a peristaltic wave seen beginning in the left inguinal region and extending to the region of the pylorus. A stomach tube was inserted which passed easily, and five quarts of a dark-brownish fluid was withdrawn. The patient was placed on rectal feeding and gastric lavage was used three times daily for three days. At this time a laparotomy was performed. The stomach had contracted to the level of the umbilicus and there was a cicatricial mass in the pyloric end, causing practically a complete obstruction of the pylorus. A gastro-enterostomy was performed. The patient did very well for nine days, when she died suddenly from pulmonary embolism. Examination of the esophagus at the post mortem showed no evidence of injury from the swallowing of the acid.

Treatment.

The treatment of corrosive esophagitis is principally symptomatic at first. Rectal feeding, ice, narcotics. Examination with bougies should not be undertaken as long as there is any evidence of recent ulceration. Such ulcerations usually continue from two to four weeks, according to the degree of the burn. After four weeks bougies may be passed as a prophylactic measure against the formation of strictures.

PHLEGMON OF THE ESOPHAGUS.

Phlegmonous inflammation of the esophagus is of rare occurrence. This purulent inflammation may occur after penetrating injuries, and injuries caused by caustics or from extension from abscess of the stomach, and by rupture of a peri-esophageal abscess. The inflammation may be circumscribed or diffuse, extending over large areas. Abscesses may form with bulging of the mucous membrane of the esophagus, causing an obstruction. These abscesses usually rupture spontaneously into the esophagus. The symptoms in these cases vary; fever, chills, difficulty in swallowing, pain along the course of the esophagus, especially behind the sternum. There may be coughing and regurgitation of pus if there is abscess formation. The treatment is ordinarily symptomatic, but some authors suggest esophagoscopy and incision in case of abscess formation.

ULCER OF THE ESOPHAGUS.

Various forms of ulceration are met with in the esophagus: gangrenous ulcers from pressure, syphilitic, tubercular and the peptic or round ulcers. Gangrenous ulcers may be caused by pressure from within or from without. Goitre or some other tumor may make pressure upon the cricoid or one of the tracheal rings, causing pressure on the esophagus, resulting in a necrosis of one or both of the walls. Aneurysm of the aorta may act in the same manner, also foreign bodies from within.

Syphilitic ulcers may occur in the esophagus, but are very rare. They usually are situated in the upper portion of the tube. The lesion is usually a gumma, and frequently results in scar formation, causing constriction. In many cases the diagnosis is made by noticing the effect of anti-syphilitic treatment.

The occurrence of tuberculous ulcers has recently been positively determined, but they are very rare.

Peptic or round ulcers, analogous to those found in the stomach, occasionally are found in the esophagus. They are frequently associated with ulcers of the stomach and are situated in the lower portion of the esophagus. They may or may not cause symptoms, but when present they are similar to those of gastric ulcer.

NEW GROWTHS OF THE ESOPHAGUS.

Carcinoma is the most frequent of the new growths of the esophagus, in fact it is the most common disease met with in the esophagus. It may occur either primary or secondary. When secondary it usually occurs by direct extension from neighboring organs. It may occur through inoculation from the secretion of a carcinomatous ulcer higher up in the gastrointestinal tract.

Carcinoma of the esophagus is most common in the male and, the same as other carcinomas, is usually a disease of advanced life.

It is usually situated at one of the normal constrictions of the esophagus corresponding to the cricoid cartilage, the bifurcation of the trachea and the hiatus of the esophagus. This fact rather favors the view that there may be some connection between repeated irritations and the development of carcinoma, as these portions of the esophagus are constantly subjected to irritation more than the rest of the canal.

Strictures are also most common at these points, so it is possible that carcinoma develops in a cicatricial stricture or some other scar.

It is estimated that about fifty per cent of the cases of esophageal carcinoma occur at the cardia, or just above where the esophagus passes through the diaphragm. About forty per cent are found near the bifurcation of the trachea, and less than ten per cent in the cervical portion of the esophagus.

Symptoms.

The most important and usually the earliest symptom of carcinoma of the esophagus is dysphagia. The manifestations are those of a slowly-advancing stenosis. The patient usually comes giving a history of having been in good health until a few months ago, when he began to have some difficulty in swallowing meat or other coarse food. This condition gradually becomes worse, when the patient has difficulty in swallowing soft foods, and finally confines himself solely to liquid food. Usually by the time the patient consults a surgeon he has lived on liquids for a considerable period on account of the difficulty of swallowing solids. Hand in hand with the difficulty of swallowing, there is usually a sense of weakness and a progressive loss of weight.

Considerable improvement may be noted upon the administration of non-irritating liquid foods. A gain of several pounds is possible for a short time by giving an abundance of milk, cream and raw eggs. There is seldom any vomiting, but usually a regurgitation of food and large quantities of mucus. This regurgitation may take place very quietly and is entirely different from vomiting. In the later stages the accumulation of thick, tenacious mucus above the stenosis may cause gagging and retching, which is very annoying.

It is not uncommon to have some hoarseness rather early, gradually becoming more pronounced on account of the further involvement of the recurrent laryngeal nerve.

As a rule there is more or less pain associated with carcinoma of the esophagus. This is described as a sense of burning or pressure in the throat or chest, especially during swallowing. Occasionally the pain precedes the dysphagia. It is frequently felt in the back, radiating to the shoulders and the back of the neck. The loss of weight and strength in these cases is at first due to the dysphagia, and later they result also from the malignant pathological process. In advanced instances it is not uncommon to have a contracted pupil on one side. According to Hitzig this is found in about one-sixth of the cases. The left pupil is most frequently involved. It is due to pressure upon the sympathetic nerve.

While an involvement of the recurrent nerves may occasionally be found as an early symptom, it most often means that the disease has made considerable progress. The pressure may be due to the growth itself, but is probably most often due to an involvement of the lymphatic glands.

Besides hoarseness, this pressure may cause attacks of dyspnea.

Diagnosis.

By taking a careful history one can usually obtain many important diagnostic points.

In a patient with slowly-progressing stenosis, and the absence of any traumatic, specific or other etiological factor, the obstruction is more apt to be due to new growth than to a cicatricial stenosis. Then if the patient be past forty years of age, is a male and the above-mentioned symptoms are

present, with emaciation and cachexia, the diagnosis of carcinoma is fairly certain.

On palpation there is occasionally a tumor or induration felt in the neck. This may be the primary growth, but most often it is metastases of the lymphatic glands. Examination with bougies may further aid in the diagnosis by determining the existence of an obstruction and its location. This examination may prove negative, even though a carcinoma be present. The growth may be so small that the bougie may glide past without offering a definite resistance. A negative examination may also be due to the fact that necrosis has taken place, and the position of the growth projecting into the lumen of the esophagus may grow only in the long axis of the tube, so that it causes no marked obstruction. When ulceration has taken place more can often be determined by passing a stomach tube or hollow bougie, as particles of tissue may become caught in the fenestrum of the tube and the diagnosis positively determined by the examination of such fragments.

It is often difficult to differentiate between carcinoma of the esophagus and aneurysm of the aorta.

If one will bear in mind the arrangement of the lymphatic glands of the mediastinum, he can readily perceive how two conditions so diverse as an aneurysm of the aorta and carcinoma of the esophagus may cause almost identical symptoms.

The lymphatic glands are in actual contact with the esophagus, so that often secondary involvement occurs very early. This being the case, we have a tumor growth in the mediastinum which may cause the ordinary signs and symptoms caused by an aneurysm in the same location. The glands may enlarge so much more rapidly than the primary tumor that there may be symptoms of intra-thoracic pressure before there are any signs of obstruction of the esophagus. In such a case as this, the symptoms would naturally be the same in both conditions, being due to pressure on the same structures.

Dyspnea, which is a fairly constant sign in case of aneurysm of the aorta, is also almost as constant a sign in carcinoma of the esophagus. In both the aneurysm and the mediastinal metastasis from the esophageal cancer the dyspnea is due to pressure on the bronchi or trachea. Dysphagia very naturally causes the surgeon to think that he is dealing with a growth of the esophagus, but in many cases of aneurysm of the aorta the esophagus is affected sufficiently to cause dysphagia. Even though the aneurysm does not press directly on the esophagus, it may cause dysphagia by pressure on the vagus, or its esophageal branches.

Thus we see that it is often difficult to differentiate between carcinoma of the esophagus and aneurysm of the aorta, when the growth is situated in the thoracic portion of the esophagus, especially if there is an early involvement of the mediastinal glands.

Prognosis.

The prognosis of carcinoma of the esophagus is always unfavorable. So far as known no permanent cures have been effected even after resection. The average duration of the disease is from six months to two years. The majority of the cases usually succumb one year after the manifestations of the disease.

Death usually takes place slowly from inanition and carcinomatous

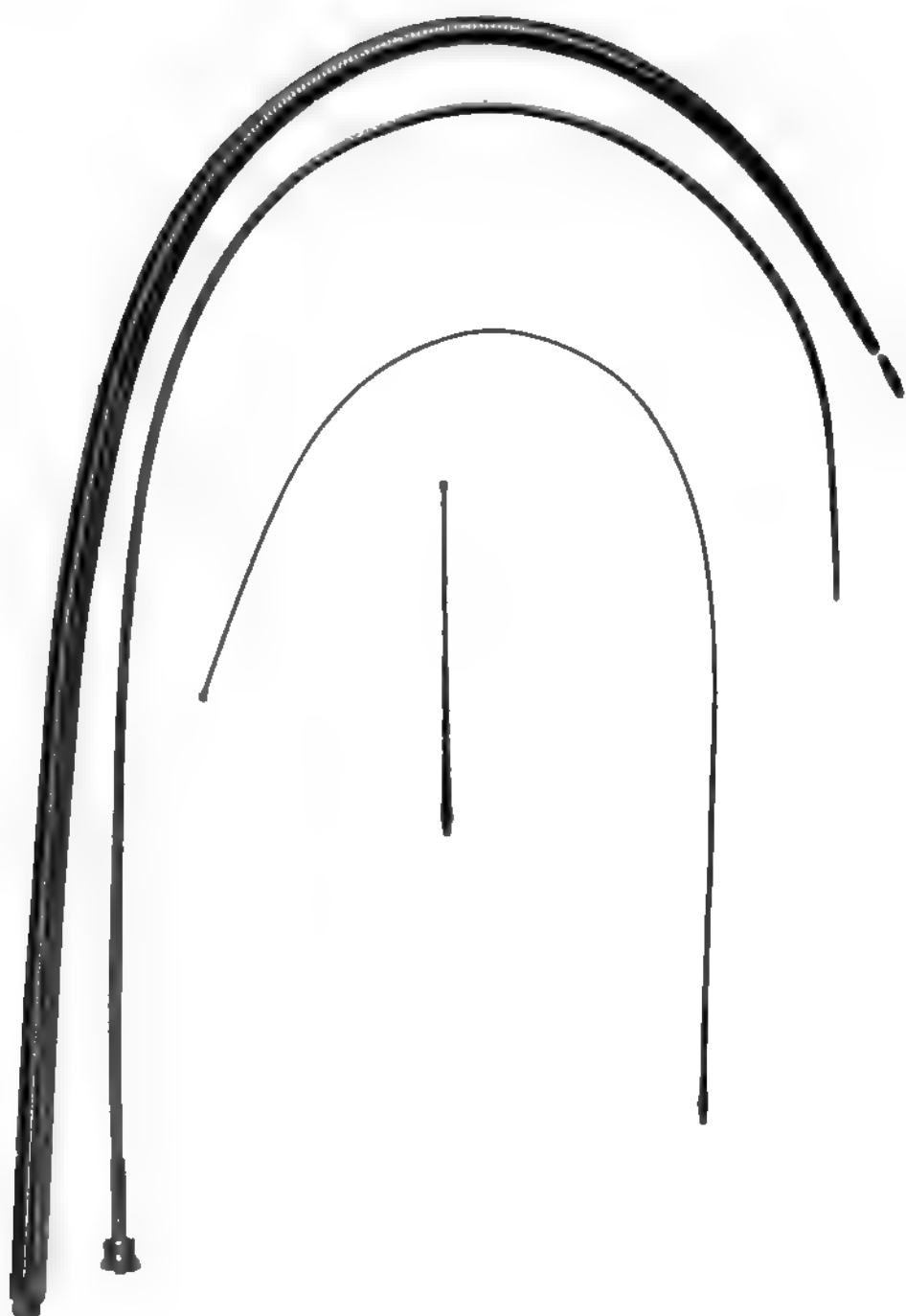


PLATE LXV.

ELASTIC DILATING BOUGIE ESPECIALLY DESIGNED FOR ESOPHAGEAL STRICTURE.

1, Graduated flexible bougie hollow, made of spiral steel; 2, Lead rod to be placed in lumen of 1 enabling the operator to give the bougie definite curves 3, Short, 4 long, filiform bougie to be screwed into the distal end of 1



cachexia, or there may be the typical picture of pyemia. Where there is a perforation and rupture into the air passages, death takes place from pneumonia or gangrene of the lung. Occasionally these patients meet with a rapid and sudden death from erosion and rupture into the large blood vessels.

Treatment.

The treatment comprises the following non-operative procedures, viz., dilatation with bougies and dilation by permanent tubage. The operative methods are resection of the esophagus; esophagostomy and gastrostomy.

Dilatation.

Dilatation with bougies is quite generally employed, especially by the general practitioner. This is usually successful for a time, as the soft carcinomatous tissue yields readily. This form of treatment is often unavoidable as the patient will not consent to the operative procedures. It should be borne in mind that the bougies cause mechanical irritation, and that the growth may be excited by their use. Great care should be exercised in the use of the bougies on account of danger of perforating into the neighboring organs during the procedure.

The conical-shaped English bougies are the best for this purpose, as they are soft and pliable. The bougies are introduced as described above. Occasionally the carcinomatous stricture will be so small that it will be impossible to pass the bougie through it. Then a filiform bougie may be passed, to the end of which is attached a conical spiral bougie shown in Plate LXV. When this is withdrawn a small-sized English bougie is passed, followed by the larger sizes. Some temporary relief is afforded in this manner.

Permanent dilation by introducing a hard rubber tube into the stricture is seldom used. Unpleasant accidents may occur, such as breaking or swallowing the string, and the constant presence of the string in the mouth is very annoying to the patient.

Operative Procedures.

Resection of the Esophagus.—The majority of cases of carcinoma of the esophagus are not accessible to radical treatment. The authors have had no personal experience in resection of the esophagus for carcinoma. In the few cases recorded in the literature of the subject the immediate mortality is high and the relief in the other cases was only transitory.

It is quite probable that with further development of Sauerbruck's method of operating within a pneumatic cabinet under negative pressure, a satisfactory operation for resection of the esophagus in cases of carcinoma may be made possible.

Esophagostomy.

Esophagostomy is occasionally performed and the patient fed through this fistulous opening. This operation is applicable only in cases of carcinoma situated high up in the cervical portion where the opening can be made below the stricture. It is doubtful whether feeding through an esophageal fistula is less annoying to the patient than through a gastrostomy opening; the detail of the latter proceeding being much easier for the patient to carry out himself. As a rule a gastrostomy is preferable to an esophagostomy as a means of these patients taking nourishment.

The technique of esophagostomy is described under the subject of foreign bodies in the esophagus.

Gastrostomy.

Gastrostomy is indicated where the patient cannot take enough food by mouth, as is shown by rapid emaciation. The earlier the operation is performed, the more satisfactory will be the result. If a positive diagnosis of carcinoma is made, a gastrostomy should be done, even though the patient can still swallow liquids. Of course a gastrostomy cannot stop the progress of the disease, but it may inhibit ichorous decomposition, which is caused by food remaining in the ulcerated area. As a result of the operation the carcinoma may grow less rapidly, because the continuous irritation from the passage of food has been relieved. Oftentimes both physicians and surgeons decide upon an operation too late. This accounts for the fact that the mortality is rather high in this operation. If gastrostomy is performed at the proper time, the life of the patient may be prolonged for several months, or even more than a year.

In choosing the operation it is necessary to select a method which may be rapidly carried out and at the same time effect a closure of the fistula.

Preparatory Treatment.

If the obstruction is complete the operation should be done at once after securing an evacuation of the bowels by means of a large enema. So long as there is still a slight passage in the obstruction it is well to administer some saline mineral water freely every morning for several days, in order to secure a free evacuation of the bowels, because one frequently finds large accumulations in the colon in these cases, as they have usually been constipated for a long time, and they will bear an operation much better if there is no decomposing substance in any part of the intestinal canal.

If the patient is very weak it is frequently possible to increase his strength considerably by giving some of the various concentrated pre-digested foods in considerable quantities at regular intervals of two or three hours for a few days. Ordinarily, however, they bear the operation well if performed rapidly and with a minimum amount of traumatism, so that it is only necessary to give the above preparatory treatment to patients who have had little or no care previous to their admission to the hospital.

The field of operation is prepared as in every abdominal operation.

Technique.

The incision is made through the outer edge of the left rectus abdominis muscle from one-half to three inches in length. The length of the incision will depend upon the extent of the contraction of the stomach and the thickness of the stomach wall. In case of a contracted stomach with a thick wall, it is necessary to make the incision longer than where there is a large, thin-walled stomach, so as to secure a sufficient amount of space to conduct the necessary manipulations without causing too much traumatism. As soon as the abdomen has been opened a portion of the anterior wall of the stomach is drawn into the wound and two purse-string stitches of fine silk or linen are applied, as shown in Plate LXXVI; the circle described by the first stitch being about three-fourths of an inch in diameter. In each case a little more than a full circle is described, in order to provide against a possible defect. These stitches grasp all of the layers of the



PLATE LXVI

GASTROSTOMY

Represents the stomach wall drawn out through the abdominal incision with two circular purse string sutures in position





PLATE LXVII
GASTROSTOMY

The same as Plate LXVI, with retention catheter introduced through an opening which has been made in the center of the circle formed by the purse-string sutures. The portion contained within this circle has been inverted into the cavity of the stomach and the sutures have been tied and cut short.





PLATE LXVIII

GASTROSTOMY

Lembert's sutures applied to either side of the extensor in order to invert the wall of the stomach still further in order to prevent leakage along the retention catheter.



PLATE LXIX

GASTROTOMY

Represents the manner of attaching the stomach to the abdominal wall by means of cat gut sutures, uniting the stomach to the parietal peritoneum and transversalis fascia. Two deep silkworm gut sutures, which extend through the entire abdominal wall, grasp the wall of the stomach in order to act as stay sutures.

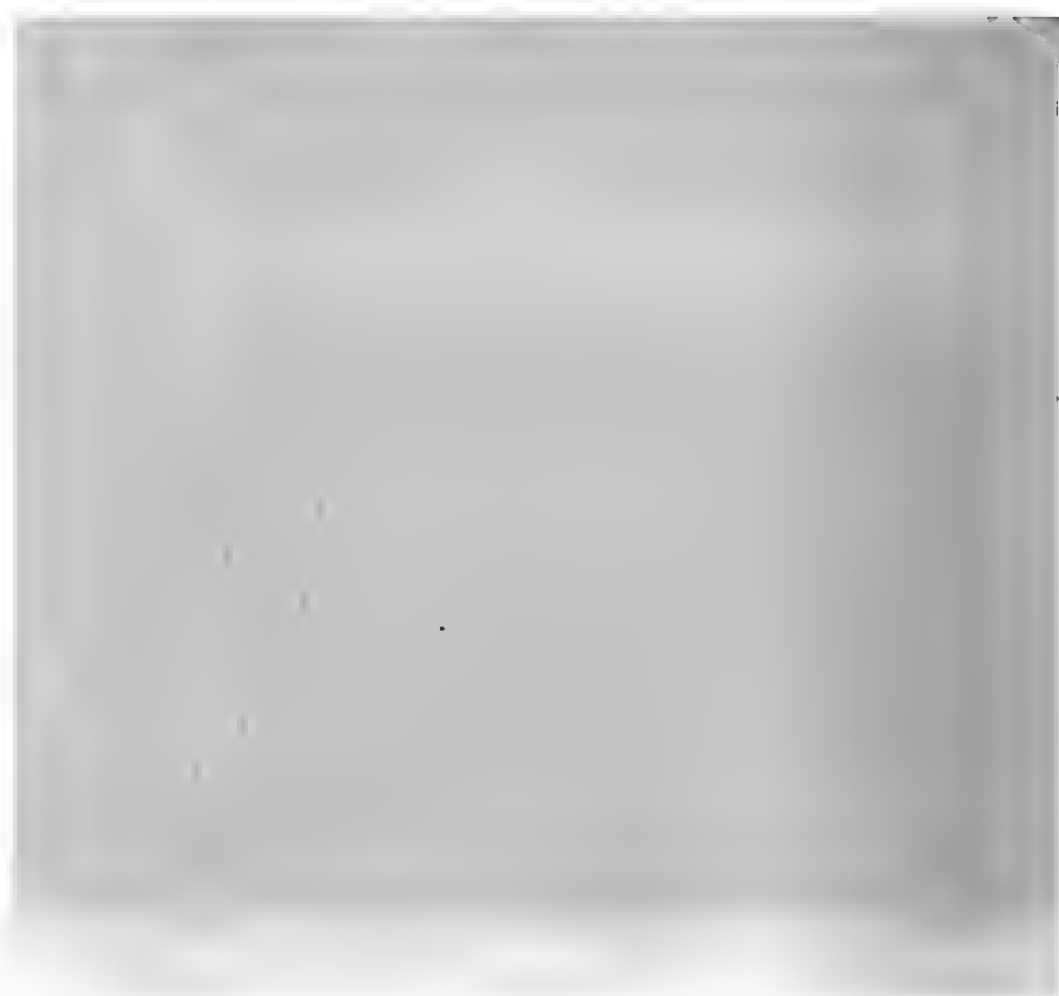




PLATE LXX

GASTROSTOMY

The same as Plate LXIX with the addition of a piece of iodoform gauze folded about the retention catheter and attached to the wall of the stomach by interrupted cat-gut sutures, in order to make the adhesion to the abdominal wall more secure



stomach down to the mucous membrane, including the submucous connective tissue. The space within the inner circle is now punctured with a trocar, and a tube from one-quarter to one-half an inch in diameter made out of rather stiff, pure rubber, fashioned after the pattern of a Jacob's retention catheter, is inserted into this opening. This will produce an infolding of the stomach wall, as shown in Plate LXVII, which is still further exaggerated when the purse-string sutures are tied.

The enlargement at the end of the tube prevents its slipping out of the opening, and the close application of the serous surface to the tube prevents any leakage. This condition is still further enforced by the application of several rows of Lembert sutures to each side of the tube, as shown in Plate LXVIII.

In a thin-walled stomach it may be desirable to apply four or five rows of these interrupted sutures, while in a thick-walled stomach two or three rows outside of the purse-string sutures will suffice. The end of the tube in the stomach should be closed with a cork or clamped with a convenient contrivance, so that no stomach contents may be expelled during the course of the operation. The important condition to be obtained is a provision against leakage, which the above-described method has always accomplished in a most satisfactory manner.

The next step is the attachment of the stomach to the abdominal wall. This is accomplished by first inserting silk-worm gut sutures through all the layers of the abdominal wall, then all the layers of the stomach wall down to the mucous membrane, then out through all of the layers of the abdominal wall on the opposite side, as shown in Plate LXIX. Then the stomach wall is sutured to the peritoneum and transversalis fascia by a number of interrupted sutures. The abdominal wound is then closed in the usual manner by suturing each layer separately, the feeding tube being permitted to pass out through the middle of the wound. A dry sterile gauze dressing is applied, the tube being permitted to pass out through the center of the dressing and the binder holding the dressing in place, so that the patient may be fed without disturbing the dressing.

In some of these patients who have become much reduced in strength, the adhesions formed between the stomach and the abdominal wall are very frail unless increased by means of some irritation. For this purpose the use of iodoform gauze has proven very satisfactory, it being applied in the following manner: A piece of iodoform gauze is folded around the feeding tube, as shown in Plate LXX, and stitched to the stomach by a number of interrupted catgut sutures. All of the other steps of the operation are carried out as above, this simply being an additional safeguard. After about ten days the catgut sutures will be absorbed and the gauze may be withdrawn. It will usually be found quite adherent and the adhesions between the stomach and the abdominal wall will have become exceedingly firm by this time.

After-Treatment.

If the obstruction has been complete or nearly so, and the patient suffered severely from thirst before the operation, half a pint of warm normal salt solution should be poured into the stomach through the feeding tube at the close of the operation, and this should be repeated every half hour until the patient is satisfied. If he had been able to swallow before the operation, he may be allowed to drink water naturally after the procedure if



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this causes no distress or annoyance; otherwise it is to be given through the feeding tube entirely. After a time the absence of irritation may cause a disappearance of the complete obstruction and then the patient will again be able to take liquids by mouth. In the meantime he should be fed regularly every three hours with peptonized milk, raw egg, the juice extracted from roast beef or broiled steak, rich broths, soups and mush. The food may be poured into the stomach through a funnel, or an ordinary glass syringe may be attached to the feeding tube and this will serve as a funnel.

Later the patient may chew any kind of food very fine, and thus mix it with saliva. He can then inject this through the feeding tube into the stomach. These patients can thus improve their digestion, especially of starchy food, and may continue enjoying their meals in this way.

Almost invariably these patients gain rapidly in weight and strength, because the enforced rest of the stomach and intestines has usually placed these organs in a condition in which they can thoroughly digest an abundance of food. We have repeatedly observed these sufferers gain sufficiently in strength in a few weeks to enable them to do hard labor, which was continued until the carcinoma had implicated some other important organ, either by invasion or by the formation of metastasis.

It is, of course, necessary to explain to the friends of the patient that this operation cannot result in a cure of the disease, but that it can simply give temporary relief. This relief, however, is so great, and the risk in obtaining it is so slight, that it is an operation which may be very strongly recommended. Aside from the distress due to hunger, and especially to thirst, patients afflicted with obstruction of the esophagus suffer pain but slightly, consequently the relief given by this operation is relatively very complete.

CYSTS, PAPILLOMATA, MYOMATA AND SARCOMATA OF THE ESOPHAGUS.

Many of the growths occurring in the esophagus, such as warts, cysts, papillomata, fibromata, lipomata, possess only a pathological interest, as they rarely cause disturbance.

Klebs has pointed out the analogy between diseases of the esophagus and those of the skin. Thus in the esophagus are found warts which are usually small and spread over different portions of the tract. It would seem probable that these warts might develop into carcinoma as is seen in skin warts, but so far such an event has never been demonstrated.

Retention cysts of the mucous glands have also been described. On account of their small size they usually do not cause any symptoms.

Fibromata and lipomata also occur, but are very rare. They are usually autopsy findings, as they run their course without producing symptoms.

Sarcomata of the esophagus are rather rare and the symptoms and course of the disease are similar to those of carcinoma. A positive diagnosis can only be made by securing a portion of the tissue for microscopic examination. The treatment is the same as described for carcinoma.

Pedunculated tumors of the esophagus are classified as polypi. They are rather rare. They are usually attached to the upper end of the esophagus in the region of the cricoid cartilage. Small polypi cause no symptoms. The larger ones may cause difficulty in swallowing and occasionally the distal end of the polypus is thrown upwards into the throat, causing choking and difficulty in breathing.

INJURIES OF THE ESOPHAGUS.

Trauma from an Internal Source.

The injuries of the esophagus produced by violence from within are those resulting from swallowing various corrosive drugs, from foreign bodies that have been swallowed, also by passing bougies, coin-catchers and other instruments. Injuries from the passing of instruments are particularly liable to occur in the presence of pathological changes such as carcinoma, ulcer, stricture, etc. Perforation of the esophagus is a serious condition, as it may result in a fatal mediastinitis or pleuritis.

EXTERNAL INJURIES OF THE ESOPHAGUS.

The esophagus being so deeply situated injuries from violence from without are extremely rare. Wounds of the cervical portion are the most common and usually occur as a result of attempted suicide.

These wounds are usually high up on the neck in the region of the larynx or hyoid bone, so that the wound of the alimentary canal is either high up in the esophagus or in the pharynx. In these cases the respiratory passages are practically always injured at the same time.

Injury of the esophagus alone in the thoracic portion is extremely rare. This may result from daggers, bayonets or bullets. Injuries of adjacent organs, as heart, lungs, large vessels, etc., which are usually fatal in themselves on account of their character and anatomical position, are apt to occur at the same time. The danger from injury to the esophagus is in itself very dangerous on account of the escape of food into the surrounding tissues, resulting in ichorous abscesses, mediastinitis or pleuritis.

Treatment.

When the injury is in the cervical portion, the first thing is to control the hemorrhage and to avoid asphyxia. It frequently is necessary to perform a tracheotomy. If the condition is such as to warrant an operation an attempt should be made to suture the esophagus, also the trachea if that has been severed. The best method is that employed in suturing the intestines, first suturing the mucous membrane and then the muscular coat over this.

Should the injury be in the thoracic portion the treatment is practically hopeless, being usually limited to feeding the patient per rectum or through a stomach tube, if this can be passed down through the injured portion. If the patient is able to stand an operation a gastrostomy will be the best method of feeding.

FOREIGN BODIES IN THE ESOPHAGUS.

The lodgment of foreign bodies in the esophagus is not an uncommon condition and is classed as one of the emergencies in the practice of surgery, as they frequently require prompt action on the part of the surgeon. The accident is most often seen in the very young and the insane. The foreign bodies most often found are coins, buttons, pins, keys, glass beads, bones and various kinds of small toys. Foreign bodies are frequently found in food, such as fish bones, fruit stones, pieces of glass and enamel. In adults the most frequent foreign body found in the esophagus is a

poorly-fitted dental plate which had not been removed at night or which had been swallowed during an attack of syncope or convulsions.

From what has been said one can see what a great variety of foreign bodies may enter into consideration. The situations at which foreign bodies may become lodged depends considerably upon the nature and size of the object. Small pointed bodies which penetrate the mucous membrane easily may lodge at any point along the esophagus. Very large bodies as a rule cannot pass the isthmus and remain lodged in the pharynx. Small, sharp-pointed bodies, like fish-bones and wooden splinters which project from a morsel of food, are apt to be driven into the wall of the pharynx during the first act of swallowing. Large bodies which pass the isthmus may become impacted at the upper border of the cricoid cartilage, where the esophagus is crossed by the left bronchus, or where the esophagus passes through the diaphragm.

Symptoms.

The symptoms vary according to the situation of the object, according to its size and shape and the amount of obstruction present and also to the amount of pressure exerted upon other organs, as the trachea or larynx. There is usually nausea, a sense of obstruction and pain on attempting to swallow and occasionally a reflex cough. If the body is large and remains in the pharynx it may press upon the opening in the larynx and cause choking, accompanied by cyanosis, etc.

If there is complete obstruction all food will be regurgitated. When the obstruction is high up in the esophagus the regurgitation will take place immediately on attempting to swallow, if it is low down a little time may intervene before the food is regurgitated.

In cases in which the foreign body has sharp edges which cause injury the patient complains of a stabbing pain at a definite point on attempting to swallow. This point is apt to be the location of the obstruction when the foreign body is situated high up.

When the impaction is lower down the pain is usually referred to the region of the sternum, though the obstruction may be at a lower level.

Diagnosis.

Occasionally a positive diagnosis of an impacted foreign body can be made from the history and symptoms. On account of the serious complications that may arise from a foreign body remaining in the esophagus a long time, an attempt should be made even in doubtful cases to determine the presence or absence of such a substance.

The pharynx should be inspected by means of a mirror, and palpation made with the finger. External palpation should be made, as large bodies in the cervical portion can often be felt, or there may be a point of tenderness corresponding to the location of the object.

In most cases a foreign body can be found by passing a bougie, also its situation determined in this manner. The best bougie for this purpose is a whalebone staff with a cylindrical tip of ivory or metal. On touching a foreign body with such an instrument a clicking or rubbing sound can be heard or at least felt.

Examination with the X-ray, either by means of the fluoroscope or X-ray photograph, is an important aid in diagnosis and has proved to be very practicable in many instances.

The esophagoscope may be used in these cases both as a means of diagnosis and treatment.

The early use of the esophagoscope for the removal of a foreign body must be strongly urged. During the first day or two after a foreign body is lodged there is very little inflammation present, but after three to four days or a week inflammation becomes intense, abscess formation occurs, perforation of the wall of the esophagus is apt to take place, and above all, after a short time the inflammation surrounding the foreign body makes it difficult to extract. So whenever a foreign body is lodged in the esophagus in an inaccessible position, and when it cannot be pushed down or brought up, the esophagoscope should be used at once, and in a great many cases the foreign body can thus be extracted.

Treatment.

The treatment of foreign bodies should be instituted as soon as the diagnosis has been made. The various methods in which no cutting operation is concerned should be tried first, namely, extraction through the mouth, forcing the foreign body down into the stomach, extraction with the aid of the esophagoscope.

Extraction by the Aid of the Esophagoscope.

After an examination of the esophagus has been made with a bougie and the location of the foreign body has been determined, esophagoscopy should be undertaken with the intention of extracting the foreign body through the mouth, or pushing it into the stomach.

In many cases a foreign body may be removed by aid of the esophagoscope, thus avoiding an esophagotomy or possibly a gastrostomy.

Esophagostomy should only be attempted by those who have had special training and have mastered the technique.

Pushing the Object Down Into the Stomach.

A foreign body should not be pushed down into the stomach, unless one is fairly certain that the procedure will not be a disadvantage to the patient. The cases in which this method is justifiable are those in which the foreign body is smooth and is not too large to pass the pylorus, and where it cannot be easily grasped with extraction forceps. Also in cases of a soft body, as pieces of meat, potato, etc. The best instrument for this purpose is the ordinary bougie with a cylindrical tip. In case a foreign body passes into the stomach, or is pushed down into the stomach, its passage will be facilitated by feeding the patient mashed potatoes for a few days.

Where the above methods are unsuccessful, or in cases where they are contraindicated, a surgical operation should be performed. Even though the foreign body is such that it will not likely pass the pylorus safely, it is justifiable to push it down into the stomach and perform a gastrotomy later, for the latter operation is much simpler and less dangerous than any external procedure for impaction in the esophagus.

There are two methods of approach, one by an external esophagotomy and the other by a gastrotomy. The selection of the method must depend upon the location of the impaction.

As a rule if it is at the cricoid cartilage or any place above the supra-sternal notch, an esophagotomy should be performed; if below the sternal notch a gastrotomy.

Esophagotomy.

The patient is anesthetized and placed with the shoulders well raised and a sand bag under the neck so as to throw the head somewhat backwards. An incision is made on the left side of the neck corresponding with the anterior border of the sterno-mastoid muscle. It is carried directly down to the muscle. Blunt dissection is now used until the anterior belly of the myo-hyoid muscle is reached. This muscle and the sterno-thyroid and sterno-hyoid muscles are retracted inwards. The lateral wall of the trachea can now be felt and on stretching the wound open the esophagus should be seen immediately behind the trachea. Great assistance in locating the esophagus can be rendered by placing a bougie with a large bulb in the canal and pressing toward the wound. The esophagus is now separated from its connections both anteriorly and posteriorly by means of blunt dissection, so that it is possible to bring the esophagus up near the edges of the skin wound. The remainder of the wound is now packed off with small pads so as to prevent any discharge which might come from the esophagus from infecting the wound.

An incision is now made upon the bulb and the cut edges of the esophagus grasped by means of two mouse-toothed forceps. The esophagus is now explored by means of the fingers, and the foreign body removed by the aid of a curved pair of esophageal forceps. Great care should be taken to sponge away any mucus that escapes from the passage. After the foreign body is removed, the wound in the esophagus should be closed with two layers of catgut sutures, the outer row being Lembert's stitches. A small drain is now carried down to the esophagus and all of the deep structures sutured in their normal position with catgut and the skin approximated with horsehair stitches. The patient should receive no food or liquids by mouth for a week or ten days. In well preserved patients the nourishment and fluids can be administered per rectum. In very weak individuals the nourishment may be given by passing a tube through the nose down into the stomach.

The prognosis in cases of esophagotomy depends mostly upon the time of operation. If this is done within the first 24 to 48 hours the prognosis is good. If after this time, and ulceration or perforation has taken place, the prognosis is very grave.

Gastrotomy.

Removal of foreign bodies through the stomach is justifiable in all cases in which such body is situated too low in the thoracic portion of the esophagus to be reached by esophagotomy, and which cannot be removed by other means. It is indicated, therefore, where the foreign body is situated more than 26 cm. from the teeth, as well as those in the cardiac end of the esophagus, especially in large angular or irregular-shaped bodies.

In performing gastrotomy for foreign body in the esophagus, an incision is made through the edge of the left rectus abdominis muscle or obliquely along the costal margin. Upon opening the peritoneal cavity the intestines should be packed away by means of sterile gauze pads to guard against soiling the peritoneum by any leakage from the stomach. The dome of the stomach is now brought forward and out of the peritoneal cavity if possible. The stomach wall is grasped with mouse-toothed stomach forceps and then incised. The stomach contents should be removed by packing dry gauze pads in and out through the opening in the stomach wall.

The lower end of the esophagus is now explored by passing one finger through the stomach. The edges of the stomach wound should be held well beyond the edges of the abdominal wound and a pair of esophageal forceps passed through this opening up into the esophagus and the foreign body extracted, if possible. In the more difficult cases, where various procedures are necessary in order to loosen and bring down the foreign bodies, it is most practicable to enlarge the incision and pass the whole hand into the stomach, as recommended by Richardson. If the foreign body cannot be reached with the finger and removed by the aid of forceps, the string-method, as used by Bull and Finney, should be tried. A small sound or bougie is passed either through the mouth, or from below through the gastrotomy opening. A string which has been armed with a small sponge or piece of gauze is attached to the end of the sound and pulled back through the esophagus. An attempt is now made by pulling this sponge through the esophagus to bring the foreign body up and out through the mouth, or pull it downwards into the stomach. After the foreign body has been removed, the management of the opening in the stomach depends upon the amount of traumatism of the esophagus.

If the foreign body is removed early and with little injury to the esophagus, the wound in the stomach should be completely closed by first placing a Connell suture through the two edges and covering the area with a Lembert stitch. In case the foreign body has been present for a considerable time so that it might have caused an ulcerated condition, or if the esophagus is injured considerably during the removal of the foreign body, then a temporary gastrotomy should be done for the purpose of administering food until the esophagus has recovered from the injuries. The gastrotomy should be planned so that the opening in the stomach will close spontaneously in a short time. This can be accomplished by carefully folding the serous surface of the stomach inwards around the feeding tube so there cannot possibly be any eversion of the mucous lining of the stomach. If this is done in the manner indicated the fistula in the stomach will close in a short time after removal of the feeding tube.

The most important complications which follow the swallowing of foreign bodies are hemorrhage and phlegmonous processes resulting from injury to the esophagus, ulceration, perforation or gangrene of the esophagus followed by a phlegmonous process which may lead to suppuration in the pleura, in the mediastinum, in the loose connective tissue between the vertebral column and the esophagus or result in pneumonia or gangrene of the lungs.

With the existence of any of the above complications the prognosis is usually unfavorable.

STRICTURE OF THE ESOPHAGUS.

Of the actual strictures of the esophagus, those caused by carcinoma are most frequent, the next in frequency being cicatricial stenosis, the result of the healing of an ulceration. The latter is produced by some form of traumatism, such as the swallowing of caustic alkali, acids or hot fluids. It may be caused by a wound or due to prolonged lodgment of a foreign body. It is occasionally due to typhoid ulceration.

The most common cause, and especially in children, is the accidental swallowing of concentrated lye. In adults carbolic acid, ammonia, etc., are

frequently taken, but the immediate mortality is high so only a small proportion live to develop a cicatrix. Occasionally the breaking down of a syphilitic gumma may leave an ulcer, and the healing thereof cause a stenosis. Tubercular ulceration of the esophagus is very rare. The healing of an ulcer of the cardia extending into the esophagus may in rare cases result in a cicatricial stenosis of the esophagus. Spasmodic stricture of the esophagus is not a rare condition and must always be kept in mind when considering cases of obstruction of this tube.

A pressure stenosis of the esophagus may result from extra-esophageal conditions such as tumors involving the thyroid body, tracheal and mediastinal glands, aneurysms, pericardial effusions, peri-esophageal abscess and spondylitis.

Although strictures may occur at any part of the esophagus, they are most frequently found at the site of the three natural constrictions, viz., at the entrance, at the level of the bifurcation of the trachea, and in the region of the hiatus.

Symptoms.

Difficulty in swallowing is present in all cases of stricture of the esophagus. The degree of dysphagia depends upon the degree of stenosis. In cases of cicatricial stenosis the narrowing usually develops slowly, and the dysphagia comes on gradually. At first the patient experiences difficulty in swallowing solid food, especially meat. Early in the disease there is usually a sense of pain or discomfort in the esophagus at the point of the stricture, especially during the act of swallowing. Occasionally the patients locate the stricture incorrectly, as the pain may be referred to the region of the sternum and cricoid cartilage when the obstruction is in the lower portion of the canal.

As the stenosis increases the difficulty in swallowing becomes more marked, and the patient soon develops a rather characteristic symptom of being careful to take only a small amount of food at a time, and then swallowing slowly. They frequently gag, and then carry out certain motions with the head. There is frequently regurgitation of food; if the obstruction is high up this takes place immediately, if lower down, a short time may intervene before the regurgitation occurs.

Where the obstruction is very marked mucus and swallowed saliva accumulate constituting a great annoyance to the patient by being frequently regurgitated into the mouth. As soon as the obstruction is pronounced, loss of weight takes place from lack of sufficient nourishment.

Diagnosis.

In mechanical stricture of the esophagus there is present a series of symptoms which are self-evident; of these the dysphagia and regurgitation of food are the most prominent. When a patient complains of difficulty in swallowing, or of vomiting at the time of eating, we should put him to the test and observe what happens during the ingestion of food and drink. Even though the obstruction has existed but a short time, we will observe that the patient has learned to eat slowly, to take only small bites of food and to masticate very carefully. If the stenosis is very marked even liquids will be taken slowly and it will be evident that it is an effort to cause the food to go down. If the patient is urged to eat more rapidly he will say that it is impossible. If eating is forced there will be a regurgitation of food usually mixed with mucus. This takes place without any effort on the

part of the patient and is very different from the expulsive evidences which accompany ordinary vomiting. The patient can practically always distinguish the difference between the act of vomiting and that of regurgitation of food.

If the history indicates the presence of a stenosis we can confirm the diagnosis by passing a stomach tube or bougie. Before such instruments are used a careful examination should be made to determine if there is any contraindication to the passage of these instruments.

The presence of an aneurysm or high grade arterio-sclerosis or pronounced heart incompetency render the procedure unsafe.

As a rule it is best to pass a soft stomach tube first, but the exact location and degree of obstruction may be more accurately determined by using bougies with olive tips.

The diagnosis and location of an esophageal stenosis is usually easy, but to determine the exact nature of the obstruction is often a difficult matter. In adults carcinoma is by far the most common cause of stricture. It is characterized by the symptoms described above, its onset is usually gradual although the inability to swallow solids may come on suddenly. The course of carcinoma is progressive, there is a gradual loss of weight and later cachexia. Metastatic growths should always be looked for, although they are rarely of value in the early diagnosis. As there is a tendency toward early ulceration in carcinoma the presence of blood in the stools is an important diagnostic sign. In carcinoma the passage of even a soft stomach tube usually causes bleeding on account of its ulcerating surface.

In cicatricial stenosis there will be a gradual and persistent obstruction with the absence of the above symptoms. There is usually a history of swallowing caustic acids or alkalies. This history together with the presence of a firm obstruction, as determined by passing a bougie, will usually suffice to make the diagnosis of cicatricial stenosis.

Treatment.

Much can be done to prevent the formation of troublesome strictures following traumatism of the esophagus by treating the condition before contraction takes place. After the swallowing of caustic substances, systematic sounding should be instituted in from two to four weeks. Foreign bodies should not be allowed to remain in the esophagus until ulceration has taken place.

Dilatable Strictures.

Gradual dilatation is the operation of choice in these cases. If the stricture is not too tight the woven flexible bougies are suitable for this purpose. The bougie is lubricated with vaseline, olive oil, or glycerine and passed after the method described in the part upon examination of the esophagus. In the tighter strictures a bougie with a whalebone stem, to which may be attached increasing sizes of ivory olive-shaped tips, will be found most valuable. The tip should be made long and tapering so that it will enter the stricture with more ease than the ordinary olive tip. There are many cases in which the woven flexible bougie or the olive tips cannot be passed and the surgeon is apt to pronounce the case one of impermeable stricture. However, in these cases with care and gentleness a filiform bougie can easily be passed, even though several sittings are required. In such cases several small filiform bougies, on one end of which threads are cut so as to be attached to a flexible dilator, as shown in Plate LXV, should be inserted into

the esophagus against the stricture in the same manner as filiforms are inserted into the urethra. Now by manipulating first one bougie and then another, one will usually slip through. The tapering flexible bougie is now attached to the filiform which serves as a guide while the bougie is pushed on through the stricture. After the filiform has been passed a few times, the passage of the woven flexible bougie or the olive tips can probably be accomplished. These should be passed in increasing sizes at intervals two or three times a week. After a few days when the patient has become accustomed to this procedure, the largest flexible bougie passed should be left in place for a period of five to fifteen minutes.

Many months are usually required for thorough dilatation of one of these strictures, and after the patient is apparently cured, sounds should be passed occasionally for several years.

Non-Dilatable Strictures.

In strictures which are impermeable from above, or cannot be successfully treated by dilatation through the mouth, the treatment depends upon the condition of the patient and upon the location of the stricture. If the patient is in an exhausted state from prolonged starvation, a temporary gastrostomy should be performed, and the patient nourished in this way until his general condition has improved. By this means rest is given to the affected parts and later on it may be possible to dilate the stricture from above, and if not, some form of retrograde dilatation may be used.

The most common, as well as the most serious, strictures are those at the lower end of the esophagus. The best method of dealing with these is some form of retrograde dilatation.

Esophageal strictures which are impermeable from above, will almost invariably permit the passage of a bougie from below, because the pressure of the food in trying to pass down the esophagus renders the canal basin-shaped, while on the distal side it is funnel shaped, thus naturally a bougie will pass more readily upwards through the stricture.

The Ochsner Method.

The same incision is made as used in ordinary gastrostomy. The stomach wall is brought out of the wound and a purse-string suture applied to describe a circle one and one-half inches in diameter. An incision is made in the stomach wall large enough to admit one finger. A filiform bougie is now passed through the stricture either from above or in a retrograde manner. A silk cord is attached to the end of the bougie and pulled up through the esophagus and out through the mouth. A stronger silk cord is attached to this one and in turn is drawn through downwards. This performance is repeated until a very powerful silk cord has been drawn through double and tied upon itself, as shown in Fig. 20. The feeding tube is fastened in the stomach by tying the purse-string. The silk cord is left in place, passing around through the esophagus and stomach and out along side the feeding tube, so that it cannot be dislodged by an accidental manipulation. The operation is then completed by suturing the stomach to the peritoneum and transversalis fascia.

The feeding tube is left in place for a few days while the stomach is becoming thoroughly attached to the abdominal wall, during which time the patient receives an abundance of nourishing food.

The dilatation is now begun in the following manner: by means of the continuous double cord another cord is carried through the stomach into the

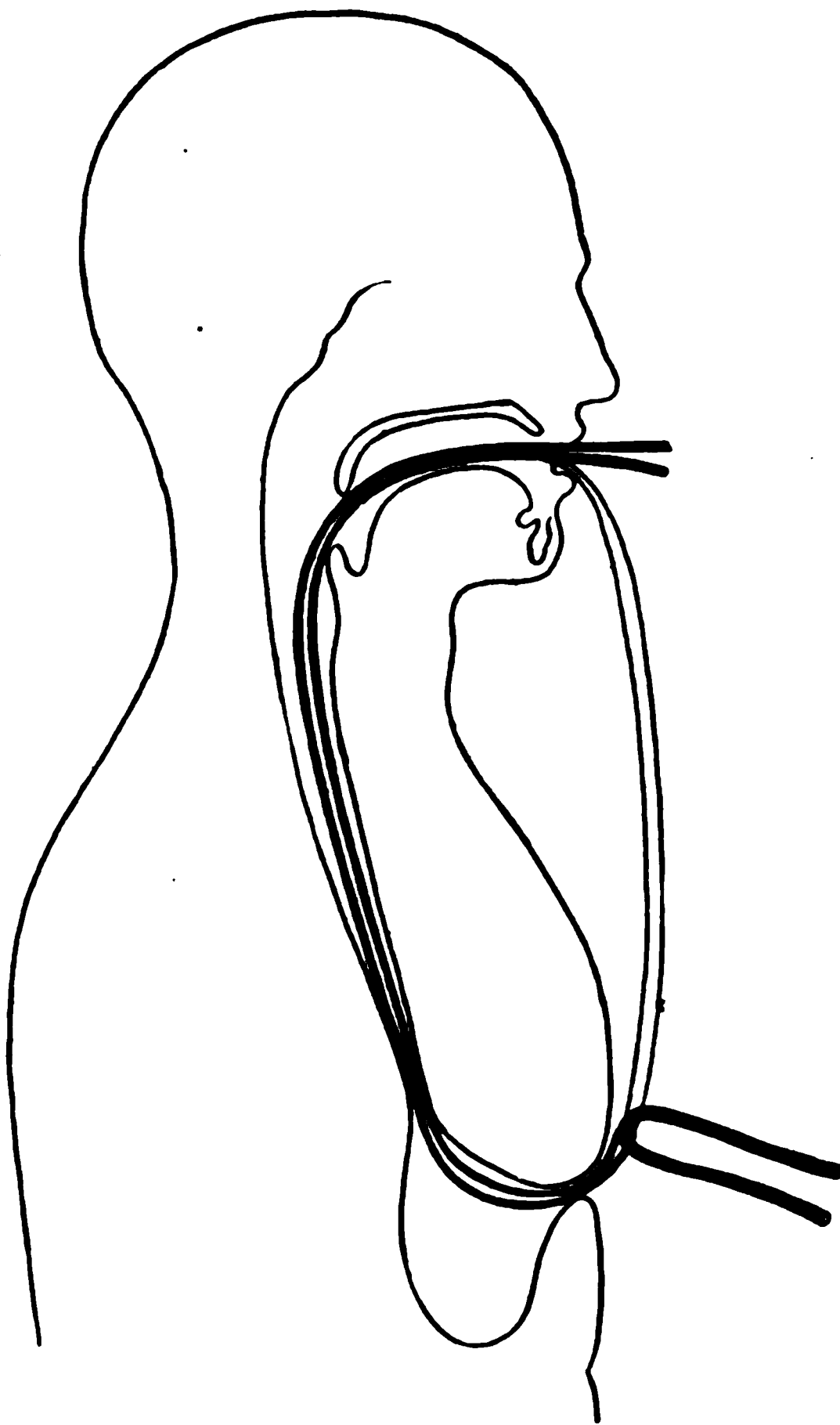


Fig. 20.

DILATATION OF STRICTURE OF OESOPHAGUS.

Shows continuous double thread of heavy braided silk passed through mouth, pharynx, œsophagus, stomach, gastrostomy wound, and from this to the mouth, a rubber drainage tube being drawn through the loop in the string for the purpose of dilating the stricture, and a second drainage tube being drawn through the loop made by the first.

For the dilatation of a stricture in the lower end of the œsophagus it has been suggested that the stomach be opened after the method just described and that then a dilator formed after the pattern of a glove-stretcher be passed through the stricture from below and the latter very thoroughly and repeatedly dilated; great care being taken however not to tear but simply to stretch the tissues, which can be accomplished only if the dilatation is made very slowly and is very frequently repeated.



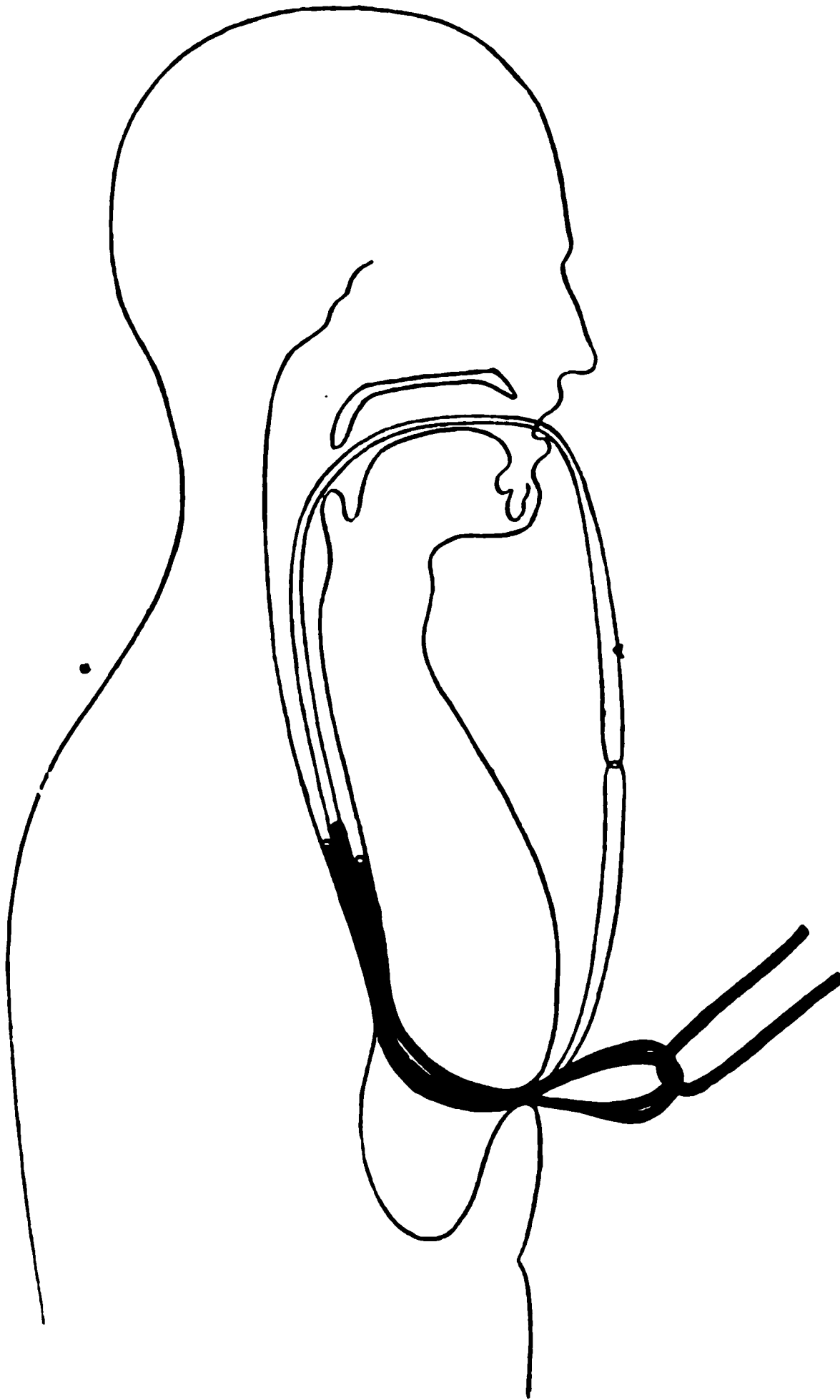


Fig. 21.

DILATATION OF STRICTURE OF OESOPHAGUS.

The same as Fig. 20, a larger double rubber drainage tube having been drawn through the loop in the first and left in the stricture temporarily for the purpose of dilating the latter.

The number and the size of these tubes may be increased until the desired degree of dilatation has been accomplished. It is important that they should be left in place in the stricture for several minutes after they have been drawn into this in order to secure the dilatation which comes from the elasticity of the rubber tubing.



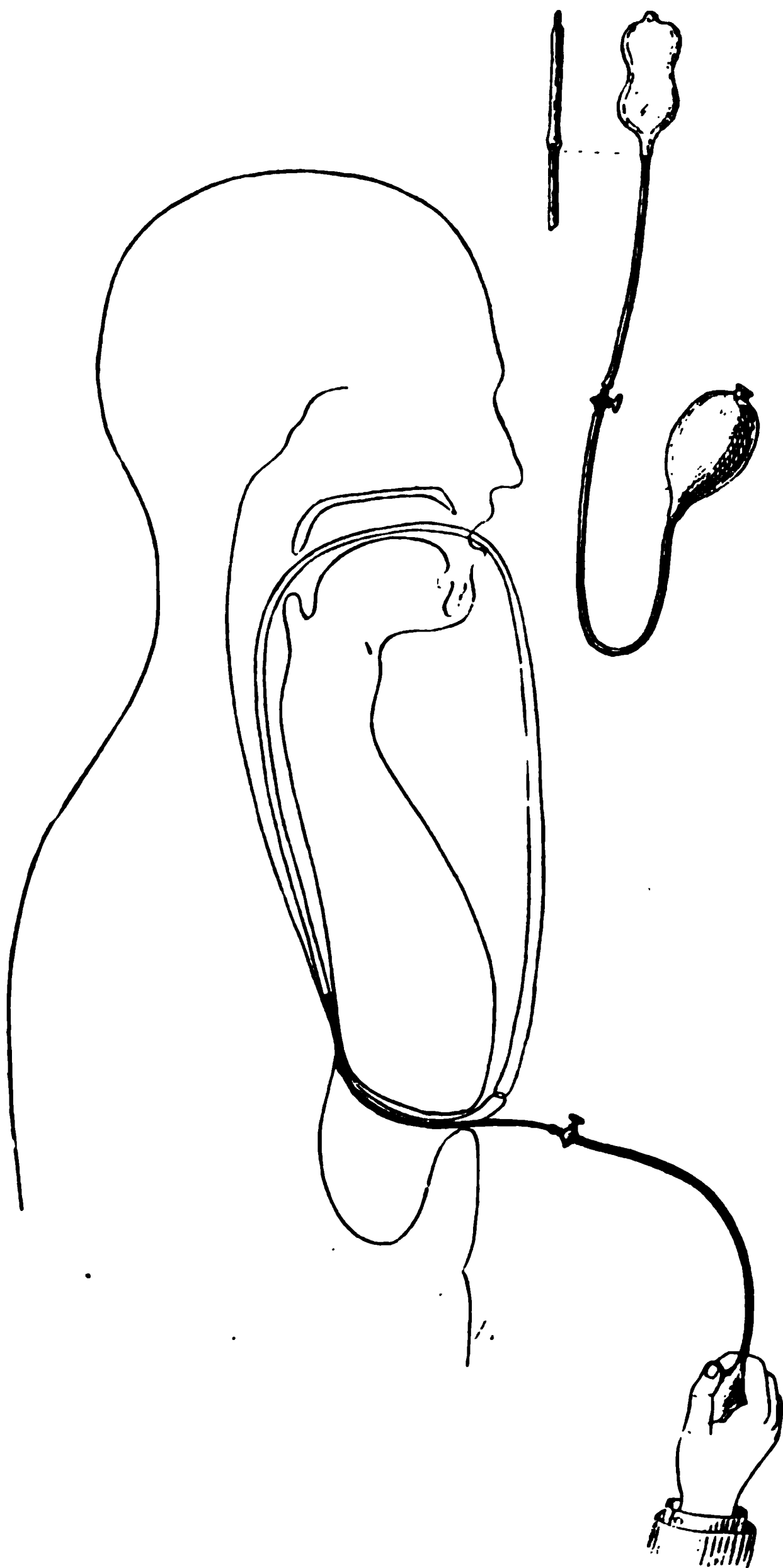


Fig. 22.

DILATATION OF STRICTURE OF OESOPHAGUS.

Barnes' dilator introduced after a partial dilatation has been accomplished by the methods illustrated in Figs. 20 and 21. The stop-cock enables the surgeon to distend the bag and to keep it distended for any desired time while engaged in the stricture.



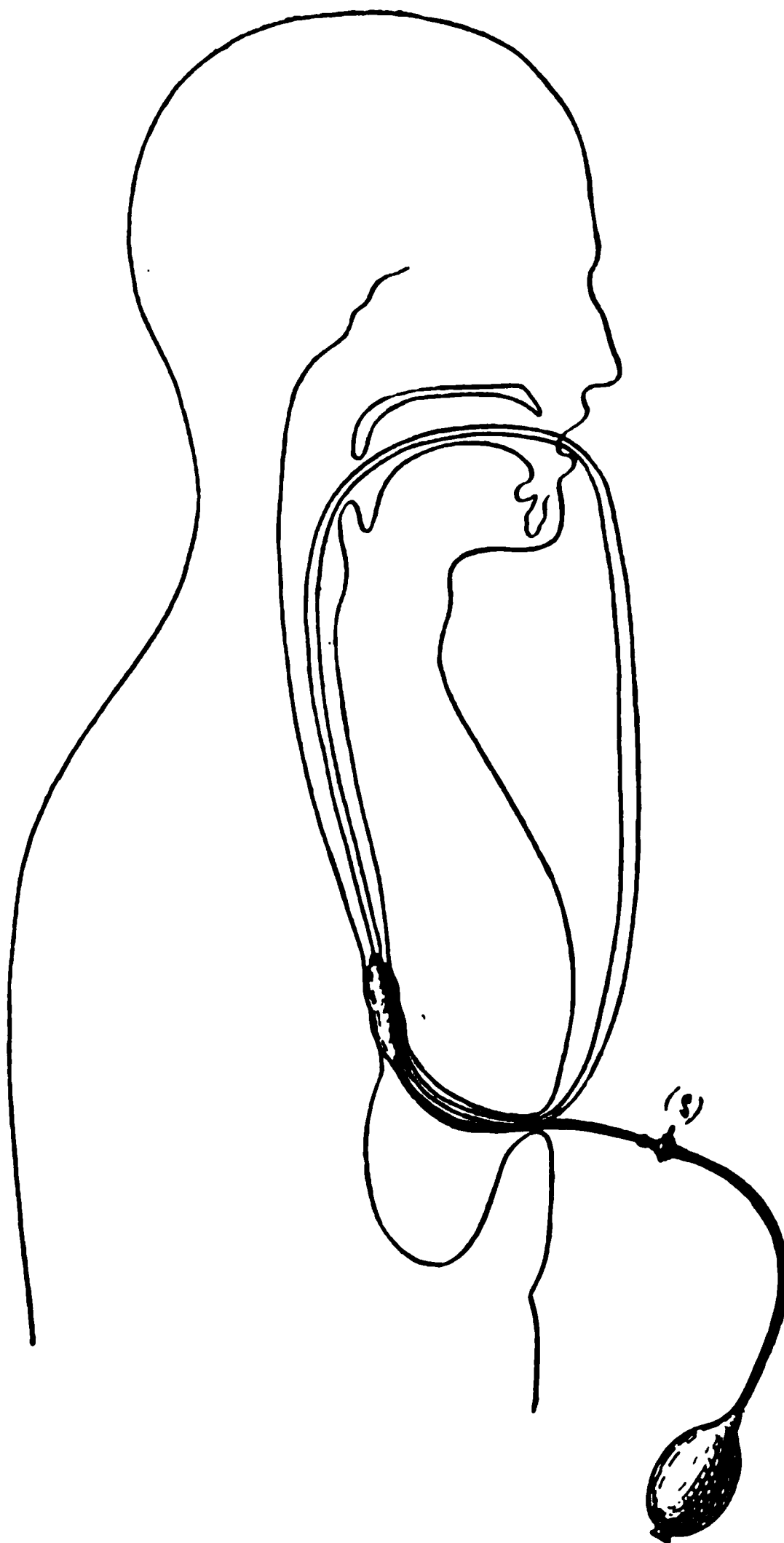


Fig. 23.

DILATATION OF STRICTURE OF OESOPHAGUS.

Barnes' uterine dilator in position; (s) shows the stop-cock, which maintains a constant degree of dilatation.

When the obstruction is at the point indicated in this figure, that is opposite the point at which the œsophagus passes through the diaphragm, it has been suggested that the stricture may be due to circular constriction of the muscles of the diaphragm surrounding the œsophagus, and in one case at least the careful division of these muscle bands has resulted in a cure of the stricture.



esophagus and out through the mouth. This cord should again be double so that a rubber drainage tube may be looped into it and drawn through the stricture, as shown in Fig. 20. In this figure, however, the rubber tube is looped directly upon the original silk cord, which is not a safe practice, because in case the cord should break it might be difficult to replace it, while there is no danger of its breaking in simply carrying through another cord.

The rubber will stretch out into a thin body when drawn through a tight stricture, but when relaxed will act as a powerful dilator. The size of the rubber tube may be increased, or any desired number may be drawn through the stricture at the same time, as the calibre of the latter increases as in Fig. 21. The rubber tubes may be drawn back and forth, the first one is drawn through the mouth and out of the opening in the stomach by means of the silk cord. The dilatation can now be carried on by looping a larger rubber tube through the loop of the other tube and by means of the latter draw the larger tube up through and out of the mouth, and then repeat this until as large a tube as desired is drawn through the stricture. This, however, requires a large opening in the stomach, which is not necessary if the tubes are simply looped into the silk cord and by alternating the direction of the pull the tube is drawn out by its free ends and in by the silk loop. Later on, a Barnes dilator in a collapsed condition may be drawn into the stricture, as shown in Fig. 22. In this plate the dilator was drawn up from below but it can be drawn down from above with no more difficulty. The fact that the dilator is engaged in the stricture can be recognized by the difficulty one experiences in drawing it into the narrow opening, and the shoulders upon the bag create a tendency to keep it from slipping beyond the stricture.

When once in place the Barnes dilator may be inflated with air by means of a rubber bulb. The patient's own feelings must serve as a guide to the degree of dilatation it is safe to make use of at any given time, and the length of time it is wise to leave the dilator in place.

Sippy has constructed a dilator superior to the Barnes, which can be used in the same manner. This consists of a rubber bag, about three and one-half inches long, encased in a silk bag, which limits accurately the distension produced. When inflated with air the circumference of the silk bag is about 15 cm. The dilating force is accurately controlled by the silk bag, and the maximum pressure exerted at the point desired. The silk bag is covered with a rubber bag to prevent friction.

If simple dilation, either by the use of the rubber tubes or the Barnes dilator, does not expand the stricture rapidly enough, the edges of the stricture may be rendered tense either by drawing a number of rubber tubes into the stricture or by the inflated bag, as shown in Fig. 23, and then using the silk cord after the fashion of a chain saw, similar to the method of Abbe, thus cutting the edges of the stricture.

After a considerable degree of dilatation has been accomplished it is well to attempt the passage of esophageal bougies from above. These should be passed every day at first, then once a week for several months and then once a month for many years. The patient may be taught to pass the bougies himself and then to report personally to the surgeon occasionally, because he often imagines that he has succeeded in passing a bougie when he has only introduced it down to the stricture.

After removing the feeding tube in these cases in which an adequate

passage through the esophageal stricture has been established by dilatation, the opening in the stomach will usually close spontaneously.

Abbe's String Cutting Method.

The abdomen is opened and the anterior wall of the dome of the stomach is brought up and sutured to the edges of the abdominal wall. An opening is made in the stomach and two fingers are inserted into the viscus and passed along its anterior wall to locate the opening of the esophagus.

Abbe (*Med. Rec.*, Nov. 20, 1907) calls attention to the fact that it is often difficult to locate the esophageal opening. In connection with this Abbe states: "This has been interesting to me from a physiological point of view. We ordinarily think of the stomach as pictured in anatomy, showing a funnel-shaped expansion of the esophagus where it joins the stomach wall. It has never been my experience to find this condition in the living stomach. As the finger passes back and forth over its upper interior aspect, one feels an even surface more like the interior of any dome-shaped cavity. This surface is maintained by the circular sphincteric muscle layers, and it is not until a moment's pressure of the finger at the right place causes them to yield that it slips upward into the esophagus.

"I have never seen this point stated in surgical works, and it has interested me as representing an always present physiological condition which prevents food regurgitation."

When the esophageal opening has been located, a long filiform whale-bone bougie guided by the index finger is passed up along the esophagus from the stomach to the mouth. To the end of this a heavy silk string is tied and pulled up through and out the mouth. A tapering bougie is now passed up along the string and through the stricture until it becomes wedged tight in the strictured portion. The string is now pulled backwards and forwards like a saw, thus cutting the tight stricture band. As the stricture gives way, the bougie is passed farther up until it again becomes tight and the string sawing is repeated until a large bougie can be passed from the stomach to the mouth. In place of passing the bougie up along the string, as described above, a second string may be drawn through the esophagus to the lower end of which a Billroth dilating bougie is tied, and by means of this string the bougie is drawn upwards until it becomes tightly engaged in the stricture and then the sawing process used as above.

The fundamental principle of this operation is, that the dilator must be pressed tightly into the stricture in order that the string moving to and fro may eat its way through the stricture. No tissue will be affected by the string, except where it is on the stretch.

The gastrostomy opening may be closed immediately after the cutting process is completed, or it may be left open for a few days until it is demonstrated that a large-sized bougie can be readily passed from above. Bougies should be passed every other day at first, then weekly, then once a month for a year and after that once each year.

Billroth's Method.

A filiform bougie is passed into a gastrostomy opening and up through the stricture to the mouth, or out through an external esophagotomy opening, and a strong thread drawn down through and out of the gastric opening. Then to the lower end are fastened in succession conical bougies whose tips are capped by a metal point into which the string is tied. From the

smallest to the largest ones they are thus safely drawn up through the stricture, with no danger of perforating the wall of the esophagus.

In performing any of the retrograde methods of dilatation one is apt to have difficulty in passing the first string through the stricture. It may not only be impossible to pass a bougie from above, but one may also experience great difficulty in finding the cardiac opening. In such cases a silk thread may be floated through from above, as advocated by Dunham. This is accomplished by having the patient swallow a silk thread down to the stricture. The patient is now given a swallow of water. As this trickles down through the stricture it may carry the thread through with it, and then the thread can be fished out through the gastric fistula.

DIVERTICULA OF THE ESOPHAGUS.

Diverticula of the esophagus are pouch-like sacculations of a portion of the circumference of the tube. The characteristic features of a true diverticulum are sharply-defined, pouch-like protrusions of the esophageal wall, lined with mucous membrane.

The symptoms vary according to the location of the diverticulum. If it is situated in the cervical portion the early symptoms may be only slight, such as dryness and irritation about the throat. Later the sensation of a foreign body may be present. As the sacculation becomes larger, the food accumulated therein crowds against the esophagus and obstructs its lumen, causing difficulty in swallowing and regurgitation of food. In about one-third of the cases a tumor can be discovered in one side of the neck after eating.

The majority of the patients learn that by holding the head in a certain position they may be able to swallow; others learn to empty the sac by making pressure upon it with the hand. It frequently requires hours for a meal. In some cases a peculiar gurgling sound is heard during the act of swallowing. In most cases there is a constant retention of particles of food in the sac, causing a fetor which may become intolerable. It is often noticed that the patient can swallow better during the early part of the meal. As the sac fills, it crowds upon the esophagus and obstructs its lumen.

Diagnosis.

The diagnosis can usually be made from the above symptoms. The history of the gradual development of these disturbances and the regurgitation of unaltered food should always arouse suspicion of a diverticulum. If a tumor develops in the neck during a meal and can be emptied by pressure, it is still more probable that a diverticulum is present. If a bougie is passed, it is usually arrested at a point near the cricoid cartilage. If the bougie is slightly withdrawn and the direction of its point changed, it may pass on into the stomach. It frequently happens that a bougie may pass readily one day and not the next. Occasionally when a bougie has been introduced into the diverticulum a second bougie may at the same time be passed on into the stomach. This would be impossible if there was a stenosis. Bismuth suspended in oatmeal gruel may be administered and an X-ray picture taken. If the sacculation is sufficient the picture will show the location and approximate size.

The symptoms of the deep-seated diverticula are vomiting or regurgitation of food during or soon after the meal. After vomiting the patients

are again able to eat for awhile. Occasionally it is found that after eating a small quantity of food there is a sense of weight or pressure in the region of the sternum. These disturbances gradually increase and larger quantities of food are vomited and less food enters the stomach so that the patient gradually becomes emaciated.

The diagnosis is based upon the clinical history and examination with bougies. For this purpose a bougie with a curved tip, like a Mercier catheter, is most convenient. With these bougies it is usually easy to pass by the diverticulum or by turning the point pass into the sacculation, and also determine whether the diverticulum is situated to the right or the left. A bismuth mixture may be administered and an X-ray photograph taken for the purpose of determining the size and location.

Treatment.

The treatment of esophageal diverticula in the cervical region may be non-operative or surgical. The non-operative consists in the persistent use of sounds and stomach tubes. Permanent benefit to the patient can rarely be expected by this method.

The surgical treatment may be palliative or radical. The palliative treatment consists in performing a gastrostomy to secure a means of administering food. When the patient is in a bad general condition, it may be advisable to perform a temporary gastrostomy in order to be able to improve his general condition preparatory to the radical operation.

This also affords a method of administering food other than by the mouth, until the wound in the esophagus has healed.

Extirpation of the sac, as first suggested by Kluge, is considered the best method for the permanent cure of this condition. The chief danger of the operation seems to be from infection, which may occur from the contents of the sac during its removal, or from leakage from the esophageal wound after it has been sutured.

The technique of the operation is as follows: An incision is made along the anterior border of the sterno-cleido-mastoid muscle from the level of the hyoid bone to the clavicle. The esophagus is reached by means of blunt dissection. No vessels of any importance are encountered except the superior thyroid and occasionally the inferior thyroid. Either one or both of these may be ligated. The thyroid gland can be drawn to one side and if not enlarged will not be in the way. The sac when located should be carefully enucleated like that of a hernia. The most important step in the operation is the closing of the esophagus after removal of the diverticulum. Probably the best method is that similar to an intestinal suture in separate layers, first the mucosa, then muscular coat and finally the adventitia, using catgut for the first two layers and silk for the last suture.

It is advisable to drain the wound by carrying a piece of iodoform gauze or cigarette drain from the esophageal suture out through the skin incision.

The treatment of epibranchial diverticula and those located just above the diaphragm is unsatisfactory. Irrigation with mild antiseptic solution will prevent irritation and ulceration of the mucous membranes. These irrigations and the passage of bougies often afford considerable relief.

IDIOPATHIC DILATATION OF THE ESOPHAGUS.

By idiopathic dilatation of the esophagus is meant a dilatation with no

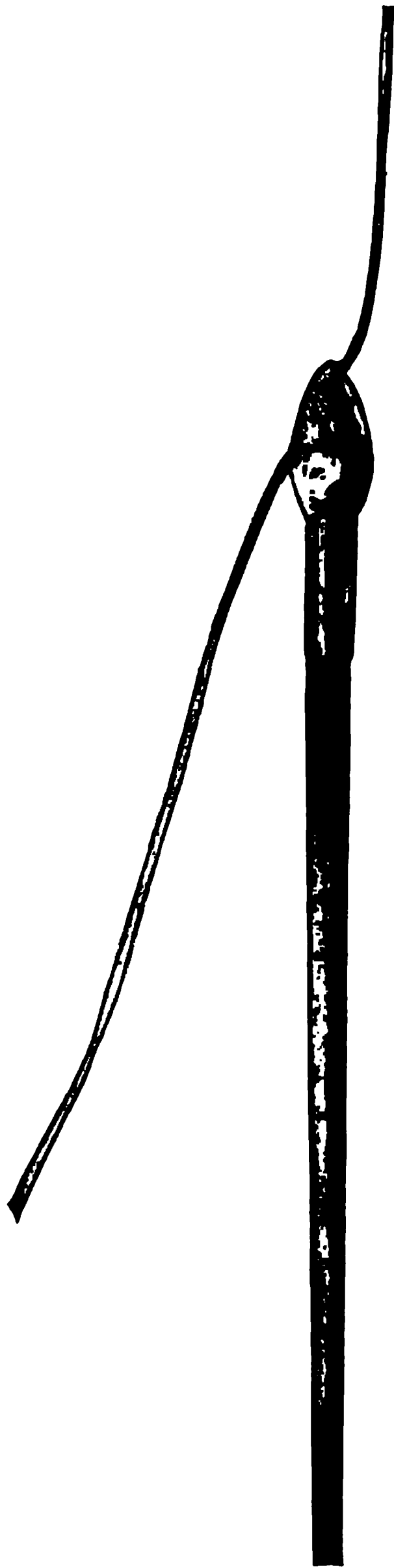


PLATE LXXI.

Plummer's whalebone staff with ivory tip drilled and threaded passing through same.



ascertainable organic cause. The esophagus usually becomes dilated throughout a large portion of its extent, sometimes involving practically its entire length in a spindle-shaped or cylindrical manner. Our lack of knowledge of the etiology of this condition is indicated by the variety of names under which the cases have been reported, such as cardiospasm, idopathic, fusiform, diffuse dilatation and dilatation without anatomical stenosis. Clinically, as far as we can judge from the history of these cases, a definite spasm of the cardia seems to be one of the earliest manifestations of the disease.

Etiology.

The cause of the spasm is a matter of speculation. In the majority of the cases a definite etiological factor cannot be found. A few cases have been reported associated with gross lesions of the esophagus such as ulcers, fissures, carcinoma of the cardia and of the stomach. Plummer has found three cases of carcinoma complicated by cardiospasm and one case of hour-glass stomach due to syphilis with secondary cardiospasm. In his study of forty cases of cardiospasm only three of the cases had neurasthenic symptoms, and evidence of esophagitis previous to the onset of the cardiospasm could not be elicited from any of them.

Symptoms. Three Stages.

The symptoms of cardiospasm may be divided into three stages; first, cardiospasm with some difficulty in swallowing but no regurgitation of food; second, cardiospasm with immediate regurgitation of food; third, cardiospasm with the dilated esophagus with retention of food in its dilated portion and its regurgitation at irregular intervals.

In the majority of cases the first attack of spasms occurs suddenly while eating. A spasmodic choking sensation is experienced at some point along the course of the esophagus, most often located in the region of the cardia. This sensation is rarely described as a pain and may be referred entirely to the epigastric region or to the upper portion of the esophagus. Sometimes the spasm is described as a delay in the passage of food, or that the food "sticks" beneath the sternum. Soon it is noticed that the patient eats very slowly and finds it difficult to swallow. It may be necessary to wash the food down with water. The patient may go through certain movements of the body and arms or take deep breaths to force the food down.

In the second stage the patient has regurgitation of food which occurs immediately after swallowing. During the early portion of the history the attacks occur periodically, but with varying degrees of intensity and with remissions or intermissions covering days, weeks, months or even years. The condition pursues its slow and unmodified course. As the cardiospasm becomes more complete, the regurgitation of food and secretions of the esophagus come on more frequently and more regularly.

In the third stage after dilatation takes place the spasmodic choking sensation may be absent. The patient is able to take the first portion of his meal quite comfortably, but the food is retained in the dilated esophagus instead of passing on into the stomach. After the sac is filled, further food is regurgitated or forces some of the preceding portion into the stomach. Of the contents of the esophagus at the close of a meal, the more fluid portion may gradually slip through into the stomach. The solid food with mucus is usually regurgitated later at irregular intervals. Solid food like meats may remain in the esophagus several days. Plummer states that the sac

never completely empties itself and that on many occasions he has withdrawn from two to sixteen ounces of food after the patient has fasted for twenty-four to thirty-six hours. The regurgitation is often looked upon as vomiting both by the patient and the physician. Some patients insist that the food enters the stomach but will not stay, while others state that it lodges beneath the sternum. They practically all complain of a sense of weight and discomfort in the chest and will also maintain that the regurgitated food is not sour.

Diagnosis.

The diagnosis of cardiospasm is apt to be difficult in the beginning, especially in patients who might be supposed, on account of their age, likely to suffer from carcinoma of the cardia. But in advanced cases the diagnosis should not be difficult. Generally the diagnosis can be premised from the history. Without previous warning there is sudden difficulty in swallowing, or the patient unconsciously gets to nibbling and following each deglutition of solid food with a swallow of water. At first liquids are often swallowed with greater difficulty than solids. After dilatation takes place the obstruction is present alike to liquids and solids.

An important diagnostic feature is that there may be little or no obstruction to the passage of a bougie even in cases in which a large quantity of food is retained in the esophagus. In the average case when a sound is passed, it will be temporarily arrested at the cardia and then when slight pressure is made it passes on into the stomach. A large bougie will often pass as easily as a small one. This is not true in case of an organic stricture. For these cases Plummer has devised an olive-tipped bougie passed on a silk thread as a guide. (Plate LXXI.)

The patient slowly swallows six yards of silk thread. This passes down through a sufficient number of coils of intestine to prevent its withdrawal on being pulled taut. He has the patient swallow three yards in the afternoon and three yards on the following morning. In this manner the first portion forms a snarl in the esophagus or stomach, which passes out into the intestines during the night, the remaining portion passing without snarling. The olive tips for threading on this string are drilled from the tip to one side of the base. The olive tip after being fastened on the end of a whalebone staff is threaded upon the silk thread protruding from the mouth. The string is now pulled taut as the sound is passed on down the esophagus. The silk thread as a guide points the bougie directly into the cardiac orifice and avoids that resistance encountered in sliding the olive along the flaring wall of the esophagus or the straightening out of some fold just as it is about to enter the cardia.

The character of the resistance met with at the cardia is of the utmost importance in the differential diagnosis of organic and spasmodic stricture of the cardia.

Excitement, overwork and worry are factors that may increase the spasm. The patient frequently awakens at night and finds food upon the pillow or finds his mouth and posterior nares filled with former contents of the esophagus. In organic stricture the retention of food and mucus is slight in comparison to what it may be from the result of cardiospasm. X-ray pictures of the dilated esophagus may be obtained by having the patient swallow bismuth subnitrate suspended in oatmeal gruel, until the choking sensation occurs, then the part photographed.

Treatment.

Forcible dilatation is the best method of treating cardiospasm. Until recently the treatment of cardiospasm has consisted in such ineffectual measures as looking after the patient's general condition; placing him under the best hygienic care; restricting the diet to fluid, non-irritating substances; effervescent drinks; administering sedatives; the passing of large bougies and, as a last resort, performing a gastrostomy. The passage of bougies has been followed by good results in some cases, but if there is much dilatation of the esophagus such results are only temporary. It is impossible to actually stretch the orifice by passing sounds, because one cannot pass a bougie large enough to produce actual stretching of the muscle fibers.

Sippy Dilation Method.

Other means have been devised to stretch the cardia. Sippy has constructed a dilatator consisting of a rubber bag about 10 cm. long encased in one of silk, which limits the distension produced. When inflated the circumference is about 15 cm. With this bag the maximum pressure is exerted at the desired point. The silk covering is encased in a rubber cover to prevent friction. A long non-elastic rubber tube is attached to the bag at one end and connected with an air pump at the other. It is essential to measure the amount of pressure within the bag during the dilatation and this is accomplished by connecting a column of mercury to the tube between the bag and the pump. The exact distance of the cardia from the incisor teeth is measured by a bougie. The bag in a collapsed condition is carried down into the cardia by means of a whalebone staff. The dilatation is now accomplished by distending the bag with air. The cardia will stand a pressure of 500 mm., but Sippy has found that from 100 to 300 mm. of pressure exerted for a period of three minutes will be sufficient to afford relief in most cases. The number of dilatations ranges from one to ten. This method of treatment is used without anesthesia.

The immediate results from this treatment are most striking. Usually the patient is able to take most any kind of food at the first meal following the dilatation. Sufficient time has not elapsed since the introduction of this procedure to formulate definite conclusions as to the ultimate outcome. In forty cases treated by Plummer, twenty-nine have remained well and in several of these the time elapsed since the dilatation is over two years. In the eleven cases in which the symptoms returned, the time elapsed after the treatment varied from three to seven months. There has been no recurrence in any case which remained well for one year.

SURGERY OF THE STOMACH.**General Considerations.**

Stomach surgery at the present time is instituted to a very large extent for the purpose of overcoming faulty drainage of this organ. In various ways the pylorus may become obstructed, so that the contents of the stomach cannot pass on into the intestine in a normal way, and as a result there is first a compensatory hypertrophy of the walls, then a dilatation with an accumulation of mucus and food remnants which are sure to undergo decomposition. This is accompanied by the formation of gas, which will further increase the distension of the stomach. This in turn produces a deformity in the outlines of the stomach, the latter taking the

form of a pouch bending downward, which increases the obstruction to the pylorus, because the food has to be elevated a considerable distance before it reaches the exit.

The normal stomach extends obliquely across the abdominal cavity, the cardiac end being much higher than the pyloric. The lesser curvature of the stomach extends almost vertically downwards for the first two-thirds of its extent, slanting only very slightly toward the right, beginning at the point of entrance of the esophagus, almost the entire curve being confined to the third nearest the pylorus. The greater curvature is more uniform and extends across the abdomen at an average angle of about 45° . It is important to bear this in mind, because it explains to a great extent the increase in the obstruction resulting from the element of dilatation, which is in itself the result of an obstruction to the pylorus. It further explains some of the unsatisfactory results which are apt to persist after the primary obstruction of the pylorus has been relieved by a plastic operation to enlarge this orifice.

The pylorus which has been thus enlarged would readily permit the stomach contents to pass if the stomach still had its normal form and position, but with the greater curvature forming a deep pouch, which has resulted from the obstruction, the emptying of this organ is greatly interfered with, even if the constriction of the pylorus no longer exists.

The principal diseases of the stomach that are amenable to surgical treatment are carcinoma, gastric and duodenal ulcers and their complications.

Gastric and duodenal ulcers will be considered together because the stomach and duodenum belong together embryologically, anatomically and physiologically, and are very closely related pathologically.

Embryologically they are formed from the foregut, the lowest end of which is marked by a more or less distinctly developed sphincter-like arrangement of the circular muscle fibres located from two to ten centimeters below the entrance of the common duct into the duodenum.

Anatomically they are separated by the pyloric sphincter, which makes itself known to a marked extent only when the stomach contains food.

Physiologically both the stomach and the duodenum serve the purpose of preparing food in such a manner that it can be readily absorbed during its passage through the remaining portion of the alimentary canal. There is but very little absorption of food as it passes through these cavities.

Functions of the Stomach.

The stomach has five clearly defined functions, which must be borne in mind in the surgical treatment of this organ.

1. It stores the food taken at one meal.
2. It secretes the digestive ferments which act in an acid medium which it also supplies in the form of free hydrochloric acid.
3. It acts as a mixing machine which saturates the food with the digestive ferments and hydrochloric acid.
4. It grinds the food into the proper consistency for the next step in the course of digestion.
5. To a very slight extent it absorbs some of its contents.

The duodenum serves simply as an extension of the stomach in which small portions of the food are again subjected to a mixing process, this time with the alkaline bile and pancreatic juice.

In the treatment of gastric and duodenal ulcers, it is of the greatest importance constantly to bear in mind these anatomical and physiological

facts, because it is plain that every surgical interference must in a measure disturb the normal anatomical conditions, and this in turn must result in physiological changes which are abnormal. Primarily gastric surgery deals with the relief of obstruction of the pylorus which is in some way secondary to gastric ulcer.

Etiology of Gastric Ulcer.

It has been accepted by those who have had the greatest amount of experience in the treatment of gastric ulcer that traumatism from within is the chief exciting cause.

A vast majority of these ulcers occur in the pyloric end of the stomach which acts more pronouncedly as the grinding machine and is consequently much more exposed to trauma than other portions of the organ.

Many clinicians and pathologists have attributed gastric ulcer to the presence of thrombosis or embolism. Attention has recently been directed to this etiologic factor again by the excellent work of Prof. Payr (*Archiv. f. Klin. Chir.*, Vol. 84), in which he reviews all of the experiments which have been made during the past half century in this connection.

Another factor which has been under discussion for some time is the theory concerning the presence or absence of certain substances in the blood which make the mucous membrane immune against the digestive action of its own secretions. It has been suggested that in the presence of these bodies a traumatism of the mucous membrane of the stomach will heal while in their absence an ulcer will result.

This seems to be borne out by animal experiments, those of Fibrich and those of Futterer being especially interesting. The latter author seems to have proved experimentally that traumatism of the mucous membrane of the stomach results in ulcer only in the presence of general anemia, and that by overcoming this anemia by treatment these ulcers will heal spontaneously and permanently. So long as there is no recurrence of the anemia there is no recurrence of the ulcer according to this author.

There seems to be no doubt but that duodenal ulcer is due, in the vast majority of cases, either to an extension past the pyloric sphincter of a gastric ulcer, forming what is usually known as the saddle-shaped ulcer of the pylorus, or it may be formed through the corrosive effect of the hyperacid gastric juice, thus virtually becoming a peptic ulcer.

Ulcers of the duodenum also occur as a result of severe burns of the skin and from thrombosis of the vessels supplying the duodenum.

Frequency of Occurrence.

Mayo and others have demonstrated that there is a much greater relative frequency of duodenal ulcer than was formerly supposed, but the exact proportion has not yet been established. It is likely that many duodenal ulcers have been overlooked in the past.

Mechanics of Digestion.

The interesting and valuable work by Cannon during the past ten years should be studied by every surgeon to obtain a correct idea of the mechanics of digestion.

It is only by a just comprehension of the physiological processes of the entire act of food digestion that one can safely undertake operative interference therewith.

It is plain that this normal arrangement must be of great value and that any surgical operation which interferes with any portion of this machine must leave the digestive apparatus seriously reduced in efficiency when compared with the normal. From this fact it is but logical to conclude that in any case of ulcer of the stomach or duodenum the patient's digestive apparatus will be in a vastly better condition to perform its physiological functions if it can be restored to normal without surgical interference. In the early stages of gastric or duodenal ulcers, experience has shown that this is possible in a large majority of cases if dietetic, hygienic and medicinal methods are carefully and persistently employed. Experience has also shown that many of these cases do not remain permanently cured but that they suffer from relapses usually more severe than the primary attack, and that after several of these "cures" and subsequent relapses many ultimately are compelled to seek relief by surgical operations. This may be explained by the theory that they were only apparently and not really cured, or that they were really cured and that later the same conditions which originally caused the ulcer to appear have given rise to the recurrence.

A careful study of the history usually brings out the fact that these patients have subjected their stomachs to dietetic abuses, that they have lived under bad hygienic conditions as regards work, rest and regular habits of life, and that they have not given proper attention to their general health, and as Futterer claims, become anemic as a result of these abuses.

On the other hand with continued control of the hygienic and dietetic influences by a physician for a long period of time, it is commonly possible to train the patient so that he will acquire such habits of diet and hygiene as will prevent the recurrence of an ulcer after it has once healed.

These injunctions are less burdensome to the patient when he knows that even after operative treatment he would still be compelled to observe more or less rigid precautions.

ACUTE ULCER OF THE STOMACH.

In acute ulcer of the stomach there are usually two very definite symptoms. The first, most constant symptom, is *pain*, which is located as a rule, about half way between the ensiform appendix of the sternum and the umbilicus. This pain is at first intermittent and occurs only after some indiscretion in diet. During this stage pain can be elicited upon pressure, regardless of whether the stomach be disturbed with food or not.

In the second place there is usually some *hemorrhage*. This may be so slight that the blood can be detected only upon careful examination of the stools, or it may be so profuse as to give the stools a characteristic appearance, or it may be so severe as to cause nausea and vomiting, in which case blood will appear in the vomitus. The blood lost may be so considerable that the patient will show marked anemia within a few days; but this symptom usually disappears in a short time if the hemorrhage subsides.

As a rule rather severe gastric hemorrhage does not require immediate operation. In nearly all of these cases the hemorrhage will cease if the patient is kept absolutely quiet and no food or cathartics are given by mouth.

These patients will stand operation much better after they have recovered from their loss of blood. The starvation should be continued for a number of days, for if a small amount of food is given before the

patient has fully recovered, the distension of the stomach is likely to reopen the bleeding vessel, and the more often this occurs, the more anemic the patient becomes. With increasing anemia, the coagulability of the blood decreases, and this in itself increases the likelihood of subsequent hemorrhages.

CHRONIC ULCER OF THE STOMACH.

Clinical observation seems to show that only a small proportion of acute ulcers of the stomach progress, either continuously or by interruption, until they become chronic. The ulcer, after its first appearance, may go on causing symptoms until the condition may rightly be termed chronic. These symptoms may vary in severity during this period, or they may continue at the same degree of severity, or there may be a complete interruption of the symptoms so that both the patient and the physician may reasonably suppose that the ulcer is permanently healed. The recurrence may be brought about by some indiscretion in diet, by unfavorable hygienic condition, or by overwork. A rather common exciting cause is indigestion from overwork, which causes a general neurotic state.

The chief symptoms of chronic ulcer of the stomach are: first, pain; second, obstruction to the passage of food; third, hemorrhage; fourth, malnutrition.

The usual location of pain, as before said, is at a point half way between the ensiform appendix of the sternum and the umbilicus. This pain is increased upon pressure; it is usually increased upon taking certain articles of food. If the ulcer is located in the lesser curvature of the stomach, to the left of its center, the pain is referred to a point a little below the center of the sternum, and pain at this point is felt if pressure is made over the upper portion of the abdomen. If the ulcer is located in the pyloric end of the stomach, but does not involve the pylorus, the pain is usually increased soon after taking food, and the greatest point of tenderness is apt to be in mid-epigastrium. If the ulcer involves the pylorus or extends into the duodenal side, there is usually a very clear-cut, definite train of symptoms, which are the same as those of duodenal ulcer. Early in the history of these cases the appetite remains good, there is no loss of weight and the taking of food brings immediate relief to all symptoms. The burning pain, the eructation of sour gas, return in from one to four hours after eating. Many of these patients suffer from nausea and vomiting, which also returns with the other symptoms. As a rule the heartier the meal the more marked and prolonged the relief. It is very common for these patients to awaken during the night with a severe burning pain in the stomach, which is relieved by taking a glass of milk or other food. Early in the disease these symptoms are periodic and alternate with complete freedom of symptoms. Later on after many attacks the patients have the same characteristic symptoms but they are less definite. The attacks are more severe and continue for a longer time; the appetite may fail or the patient may be afraid to eat on account of the pain, gas and sour eructation; food and drinks give relief, but the time of relief is shortened. Relief may also come from vomiting, irrigation and alkalies, but the pain recurs when the acid contents of the stomach return.

The characteristic point is the time the symptoms appear, and their regularity after meals, and the relief which comes from taking food, or by vomiting or irrigation.

Later when complications arise the symptoms may change. Food may not give relief but is apt to increase the pain, which is often nearly continuous. In these chronic cases it is the early part of the history which is most apt to lead us to a correct diagnosis.

Dilatation.

Dilatation of the stomach is a late symptom of gastric ulcer. It is caused by the obstruction which the ulcer itself offers in the pyloric channel, or by the cicatricial contraction which results from partial or complete healing of the ulcer.

Hyperacidity.

In chronic ulcer of the stomach hyperacidity is usually present, and in duodenal ulcer acids are practically always very high. It has frequently been claimed that the presence or absence of free hydrochloric acid in the stomach, and the presence of lactic acid, can be used in making a differential diagnosis between chronic ulcer and carcinoma of the stomach. This method is not to be relied upon as its employment is apt to lead to serious mistakes. Extensive observations by different investigators have proven that free hydrochloric acid is absent from the stomach contents in a large proportion of normal stomachs in persons over sixty years of age. Again in early carcinoma the acids are apt to be high and only go down after there is marked stasis of the stomach contents from obstruction during the later stages of the carcinoma of the stomach.

Perforated Gastric or Duodenal Ulcer.

A perforation may take place in either the acute or chronic form of gastric and duodenal ulcers. Formerly it was thought that a perforation of a duodenal ulcer was extremely rare. There is no doubt but that in the past many perforated duodenal ulcers occurred and resulted in diffuse septic peritonitis and the appendix was blamed for the peritonitis. This supposition seems reasonable because recently a far greater percentage of perforated duodenal ulcers have been encountered than was formerly supposed to exist. Occasionally in both the duodenal and gastric ulcers the perforation occurs without any previous symptoms, but usually a definite ulcer history can be elicited previous to the symptoms of perforation. Then the patient suffers from a very severe acute attack which usually follows some pronounced physical exertion. Occasionally the attack comes on after some indiscretion in diet, and only rarely does it occur without any apparent exciting cause. The patient suffers from a very acute pain in the upper portion of the abdomen and the pain is usually described as coming on with a feeling as though something had ruptured. There is early nausea and usually vomiting of stomach contents, which may or may not be mixed with blood. The abdominal muscles immediately become tense and there is a condition of shock. Physical examination elicits a rigid condition of all of the abdominal muscles, and especially those of the upper half of the abdomen. There is marked tenderness upon pressure in epigastrium and usually, but not always, an absence of liver dullness.

The pulse becomes rapid and thready. Early there is no rise of temperature, but this comes on with the progress of the peritoneal infection. If the condition is not diagnosed and relieved early, the symptoms become those of a peritonitis.

Treatment of Perforated Gastric and Duodenal Ulcers.

Immediate operation is always indicated provided the patient comes under observation during the first twelve hours after the perforation has taken place. Statistics show that the mortality in these cases is about twenty-eight per cent, while in cases which come under observation twenty-four hours or more after perforation has taken place is more than three times as great. In these latter classes the method of treatment must depend upon the judgment of the surgeon. If the condition present indicates that the leakage has not been great, or the probability of the opening being closed by a plug of omentum or by the presence of other adhesions, it may be wise to place the patient upon exclusive rectal feeding until a circumscribed abscess has been formed, which abscess may then be drained.

In the early cases the operation should be performed immediately and without any preliminary preparation. The incision should be free and in the mid-line. As soon as the abdomen is opened an immediate search for the perforation should be made. This should be carried out in a systematic manner so that the tissues will not be handled any more than necessary.

As soon as the perforation is found it is grasped and held closed temporarily by an assistant, while the surgeon carefully sponges all of the soiled areas to remove as much of the stomach contents as possible, great care being used to cause little or no traumatism to the peritoneum. The remaining portion is now shut off from the field of operation by the placing of some large gauze pads in the abdominal cavity. A stomach tube is now introduced and gastric lavage carried out until the water returns perfectly clear. The perforation should now be closed and in doing this care should be used so that the stomach will be left free from any deformity which may later cause an obstruction.

As a rule the hemorrhage has ceased by the time the operation is performed so it is not necessary to give any attention to this part of the condition.

The opening in the stomach is sutured by placing a row of Connell sutures, covered by a second row of Lembert stitches. The row of sutures should be placed at right-angles to the long axis of the stomach to prevent a narrowing which might later cause an obstruction.

Thorough drainage should be established.

If there has been an extensive extravasation of stomach contents, a second incision should be made just above the symphysis pubis and a drain carried down into the cul-de-sac, while the upper portion of abdominal cavity should be drained through the upper angle of the original incision.

If the perforation has taken place at or near the pylorus one may expect a certain amount of obstruction to follow and it may become necessary to perform a gastro-enterostomy for relief of same.

It is rarely necessary nor wise to perform a gastro-enterostomy at the time of closing an acute perforation of the stomach, because the additional time and manipulation is apt to increase the gravity of the prognosis.

Treatment of Chronic Gastric Ulcer.

There are many cases in which a permanent cure is not possible although they have received most careful dietetic, hygienic and medicinal treatment. In any given case the sooner this fact has been established the better, in order that the operation may be performed before one or the other of the various unfortunate complications may have arisen.

The most serious complications to be considered are (1) perforation, (2) hemorrhage, acute or chronic; (3) emaciation; (4) adhesion to surrounding structures; (5) the implantation of carcinoma.

Besides these serious complications which are apt to occur a number of physiological and anatomical changes develop quite constantly.

Secretion of Mucus.

In order to protect the ulcer from the irritating gastric juice a large amount of mucus is secreted. At the same time there is a contraction of the muscles in the region of the pylorus to establish a condition of physiological rest. Many of these patients do very well if placed upon an exclusive liquid diet, because with this neither the presence of mucus nor the contraction of the muscles does any harm, especially if the gastric juice is kept alkaline by proper remedies; and, if milk is given, it is medicated so that it will not form coagula.

It is quite different with solid food as on the one hand this will be rendered much more indigestible by being covered with mucus, while the obstruction caused by the contraction of the muscles in the pyloric end of the stomach interferes with the passage of the food into the small intestine.

Hypertrophy of Gastric Muscles.

To overcome the former difficulty a great amount of hydrochloric acid is secreted, while to correct the latter there is a compensatory hypertrophy of the muscles of the stomach.

Of course the hyperacidity of the gastric juice increases the irritation of the ulcer, and the muscle hypertrophy increases the traumatism, consequently both of these changes are likely to do much more harm than good.

If the ulcer has healed, in the meantime, all may still be well, but if this has not occurred, conditions are practically certain to go from bad to worse until relieved by surgical intervention. Meanwhile, the following changes may have occurred in the ulcer itself; it may have encroached upon some blood vessel of considerable size causing dangerous hemorrhage; it may have advanced to a point dangerously near to perforation, causing adhesions to other organs, or a perforation into one of these organs, the pancreas, liver, spleen, omentum or the duodenum, or into the abdominal wall may have taken place. We have personally encountered all of these conditions.

The ulcer may have perforated into the free abdominal cavity, or a carcinoma may have been implanted upon the ulcer.

The most common course, however, results in an obstruction at the pyloric end which may be due to an extensive induration at the base of the ulcer, to a cicatricial contraction as a result of the healing of the ulcer, or to a spasmodic contraction of the pyloric sphincter. This obstruction, as has been stated above, will be overcome for a time by the compensatory hypertrophy of the muscles of the stomach but if not relieved this will invariably be followed by an exhaustion of the muscles and a consequent gastric dilatation. This dilatation may be moderate in degree or it may be excessive. We have seen the lower edge of the stomach resting in the pelvis of the patient.

In the presence of marked dilatation, there always remain portions of food in the stomach and this residual food invariably decomposes so that the patient is forced to absorb products of decomposition instead of products of normal digestion. All fresh food placed in the stomach is at once contaminated by the decomposing fluid. This condition accounts for the

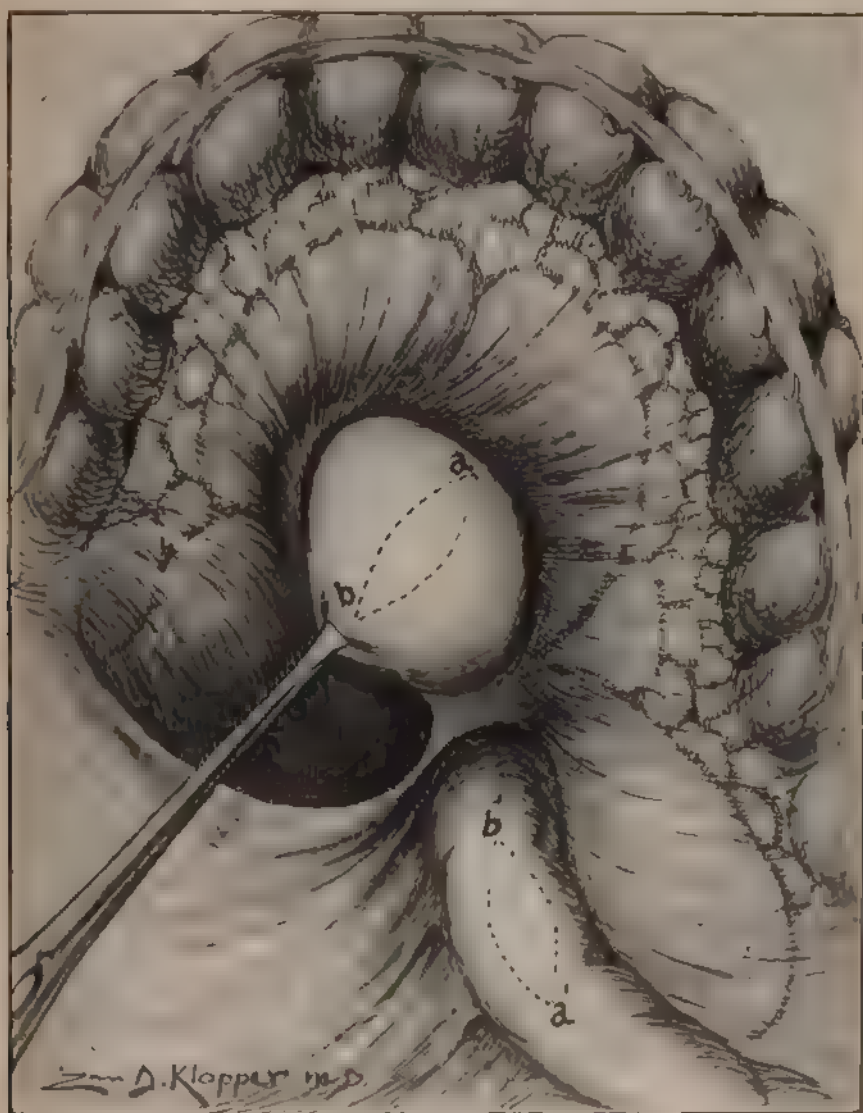


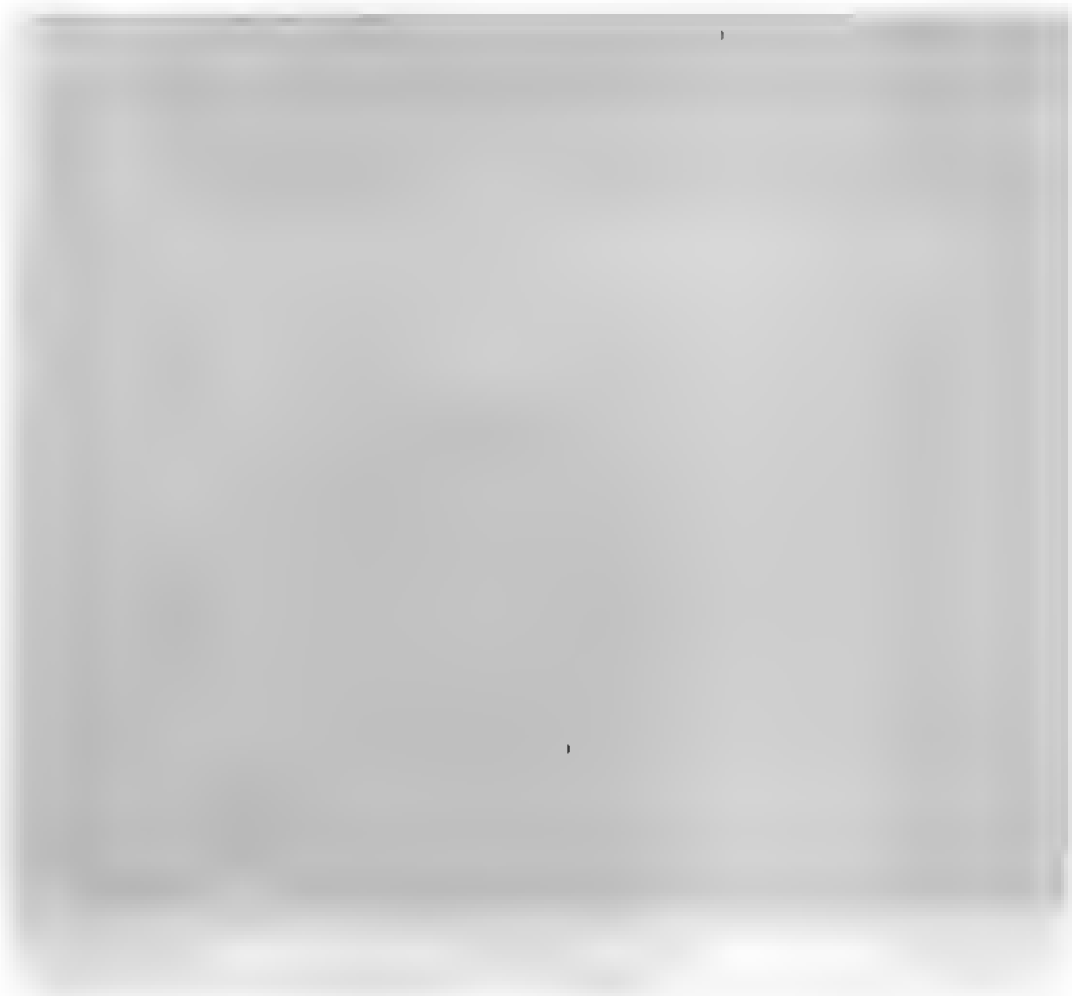
PLATE LXXII.

Mayo-Moynihan method of gastro-enterostomy, showing lowest portion of posterior wall of stomach brought through a tear in the mesentery of the transverse colon, and the points on the stomach and jejunum selected for the anastomosis





PLATE LXXIII
Mayo-Moynihan method of gastroenterostomy, showing forceps holding the
stomach and jejunum in position for suture.



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emaciation or cachexia which is invariably present in advanced cases of this kind. The marked improvement often following the systematic use of gastric lavage is easily explained when one takes into consideration the above conditions.

It is, of course, best not to delay until this extreme development before relieving the patient through surgical means.

Relief in these cases must come by supplying drainage. It has been shown by a very large clinical experience that with efficient drainage of the stomach, by way of a properly executed gastro-enterostomy, better conditions may be established for the patient than by any other present method of treatment.

Such results will vary not only with the skill of the operator but, also, as regards their permanency, with the care with which these patients avoid hygienic and dietetic abuses after recovering from the operation.

The treatment of duodenal ulcer is the same as that for gastric ulcer.

GASTRO-ENTEROSTOMY.

Gastro-enterostomy may be performed for the following conditions: First, for relief of obstruction of the pylorus; second, for the purpose of relieving the irritation due to the passage of food over an ulcer in the pyloric end of the stomach or duodenum; third, for drainage of a greatly distorted stomach; fourth, drainage of a stomach containing an inoperable carcinoma; fifth, for establishing a communication between the remnant of a stomach and the intestine after the pyloric end of the stomach has been removed.

Preparatory Treatment.

In many of these cases, not sufficiently strong to bear an operation well, because of their impaired nutrition, together with the anemia caused by the loss of blood, it is wise to treat the patient for a time before undertaking the operation. It is well in these cases to remove all decomposing substances from the stomach and intestines by the administration of castor oil, given in the manner described before in the foam of beer or extract of malt, in doses of two ounces. We have used this in many cases and have never seen the slightest harm result from it, but have, on the contrary, constantly observed great benefit. Then it is well to permit the stomach to rest completely for one or two weeks, or even longer, and to administer nourishment by nutrient enemata. Mild saline laxatives may be given by mouth because this will facilitate the healing of the gastric ulcer and will at the same time prevent constipation. Pure olive oil, given at bedtime in doses of two ounces, seems to aid in building up the patient and at the same time leave the ulcerated stomach without giving rise to any irritation.

If there are no acute symptoms it is well to cocaineize the pharynx well by spraying it with a four per cent solution of cocain. The patient should be permitted to swallow a little of this in order to anesthetize the esophagus. After waiting about four minutes, in order to give the cocain an opportunity to take effect, irrigate the stomach thoroughly with normal salt solution.

If there are any symptoms of acute inflammatory disturbance in the lining of the stomach it is better to avoid gastric lavage, as this might give rise to hemorrhage from an ulcer.

It is best not to inflate a stomach with gas so long as one suspects the presence of an ulcer, for fear of perforation, but this is necessary in order to determine positively the extent of gastric dilatation. It is safest to insert

a stomach tube for the purpose of distending the stomach with gas, and to attach it to an ordinary rubber bulb with which air can be pumped into the stomach slowly and consequently safely. After the degree of dilatation has been determined the gas may be permitted to escape through the tube.

If the patient is in fair physical condition the only preparatory treatment necessary is the administration of two ounces of castor oil the day before the operation and a gastric lavage the evening before, and again on the morning of the operation.

Incision.

An incision about four centimeters to the right of the median line will be found most satisfactory in the majority of cases, so that the stomach, duodenum, gall bladder and appendix, can all be carefully inspected. All of these organs should not only be palpated, but should be inspected as well, before it is definitely decided what procedure shall be carried out in any particular case.

During the past three years the authors have used the Moynihan-Mayo method of gastro-enterostomy, which has proved very satisfactory indeed. This operation contains the important elements reasonably to be expected in a gastro-enterostomy. It is simple. It places the opening in the lowest part of the stomach. It provides an opening large enough to prevent secondary obstruction from contraction. It establishes an immediate communication between the stomach and the intestine. It leaves the jejunum practically in its normal position and without any angulation. It leaves no loop to cause intestinal obstruction. It prevents the possibility of hemorrhage either during or after the operation. It prevents soiling of the peritoneal cavity by intestinal or stomach contents during the operation.

The first step of the operation is to select a point in the stomach wall for the anastomosis. This point should be made in healthy tissue a considerable distance from the diseased area, if possible.

It is wise to choose the most dependent portion of the stomach for this purpose, because this will secure a more perfect drainage than could be accomplished in any other way, the walls of the stomach forming a kind of funnel in which all of the sides slope down to the point of anastomosis.

Mayo has pointed out the fact that by doing this, it is possible, in almost every case, to prevent regurgitant vomiting after gastro-enterostomy.

The transverse colon is brought up out of the wound and its mesentery placed taut, as in Plate LXXII, and an opening is torn in the mesocolon at a non-vascular point opposite the crossing of the jejunum. The posterior wall of the stomach is brought out through this opening and the lowest point in the greater curvature of the stomach is grasped by a pair of tenaculum forceps, which would be at the point (a) in Plate LXXII. A second pair of forceps should be placed about 8 cm. from the first one in a direction downwards and to the right, as at (b) in Plate LXXII. This makes the opening in the stomach in normal direction of the jejunum after it passes through the mesocolon, which is from right downwards to the left in eighty per cent of cases, according to Lewis. In the other twenty per cent it is from the left downwards to the right. In these cases the opening should be from left to right in the stomach. As soon as the two forceps, marking the location and direction of the opening in the stomach, have been applied, the stomach wall lying between these two forceps should be grasped by a pair of stomach forceps, the blades of which should be protected

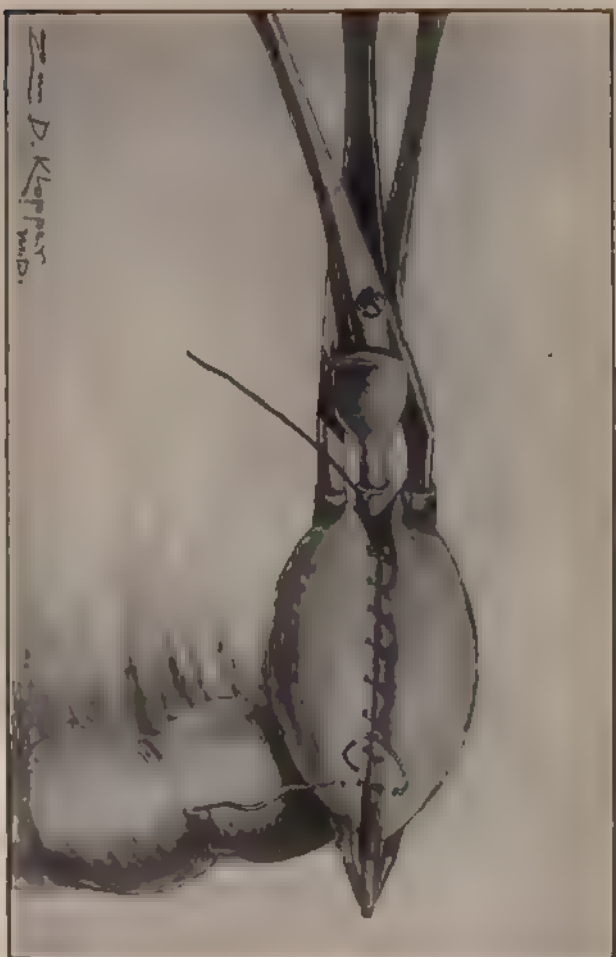


PLATE LXXIV

Mayo Moynihan method of gastro enterostomy, showing Lembert stitch in place, the incision made in the stomach and jejunum and the second row of stitches passing through all the coats of the stomach and intestines



PLATE LXXV
Mayo-Moynihan method of gastro enterostomy showing application of first Lembert stitch.





PLATE LXXVI

Mayo Moynihan method of gastro-enterostomy, showing application of second row of sutches posteriorly, which pass through the entire thickness of both stomach and intestinal wall



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PLATE LXVII

Mayo Moynihan method of gastro-enterostomy, showing application of the deep row of sutches anteriorly passing through the entire thickness of both the stomach and intestinal wall





PLATE LXXVIII

Mayo-Moynihan method of gastro-enterostomy, showing anterior Lembert stitch





PLATE LXXIX
Mayo-Moynihan method of gastro-enterostomy. Operation completed showing
relations of stomach, jejunum and transverse colon



by rubber tubing, as shown in Plate LXXIII. Care should be used to have a sufficient amount of the stomach wall project beyond the blades of the forceps to prevent tension during suturing. The jejunum is next picked up, which is found by passing the hand down along the mesocolon to a point just to the left of the spine. The jejunum is now grasped on its convex surface two to five centimeters distant from the point where the intestine passes through the transverse mesocolon at point (b') Plate LXXIII, and a second 8 cm. distant at point (a'). This portion of the intestinal wall is grasped by another pair of long-bladed forceps in the same manner as the stomach wall, and the two forceps are placed side by side, as shown in Plate LXXIII. Gauze pads are now placed about the forceps protecting all of the tissues except the small portion of the stomach and duodenum within the grasp of the forceps. The next step consists in placing a row of Lembert stitches uniting the stomach and jejunum for a distance of about six centimeters, as in Plate LXXIV. Fine silk or linen thread is usually used in making this stitch. An incision is now made into the stomach about one-fourth of a centimeter distant from the suture line, then a similar one into the jejunum. As these incisions are made any stomach and intestinal contents should be carefully sponged away to avoid soiling any of the tissues. The openings just made should be about five centimeters in length, which is one centimeter shorter than the first suture line. Plate LXXV.

A second row of sutures consisting of a running chromicized catgut stitch is placed just in front of the Lembert stitch, which passes through all of the coats of the stomach and intestine (Plate LXXVI). This stitch controls the hemorrhage and approximates the cut edges behind, completing the posterior suturing. This same stitch is now continued forward approximating the edges anteriorly, folding the edge of the mucous membrane inside, passing through all of the stomach and intestinal coats to prevent hemorrhage (Plate LXXVII). The first Lembert stitch is now continued forward approximating the peritoneal surfaces anteriorly (Plate LXXVIII). This stitch completes the anastomosis.

The opening in the transverse mesocolon should now be closed by suturing its edges along the line of anastomosis. This may be attached on the jejunal side, or the stomach, or to both, directly over the line of suture. In doing this care should be used to see that the opening in the mesocolon is large enough so there can be no constriction which might cause an obstruction by kinking the jejunum.

After-treatment of Gastro-enterostomy.

As soon as the patient recovers from the anesthetic he should be placed on a head rest in a semi-sitting posture. This position favors drainage of mucus into the intestine, which may accumulate in the stomach after the operation, and also favors expulsion of gas through the esophagus. If the patient suffers from nausea or vomiting, gastric lavage should be used. In doing this care should be employed not to distend the stomach. Not more than half a pint of water should be allowed to run into the stomach at one time. If the vomiting recurs, the lavage should be repeated.

Occasionally, the patient suffers from acute dilatation of the stomach. This condition may come on suddenly and is characterized by a sense of fullness and distension of the upper portion of the abdomen. The breathing becomes labored, the heart very rapid and the picture is one of a very alarming state. The condition can easily be relieved by passing a stomach tube. Enormous quantities of gas will escape through the tube and the patient will

obtain immediate relief. The pulse and breathing soon become normal and the patient again proceeds in a satisfactory manner.

Feeding.

If the patient is not greatly reduced, it is best to feed per rectum for three or four days, and then allow broth, gruel, or buttermilk, or some of the commercial concentrated liquid foods. In anemic patients the authors have frequently allowed liquid food on the second day with good results, and at the same time administered salt solution and some predigested food per rectum. The diet should be carefully regulated for several months after the operation so that the mechanical and chemical functions of the stomach may become as near normal as possible after the changed anatomical relations following the operation.

EXCISION OF GASTRIC ULCER.

Technique.

It has at times seemed wise to remove a gastric ulcer radically by excising it entire, and uniting the edges of the wound in the stomach. This is done especially because it has been long known that gastric ulcers are a predisposing cause to the development of carcinoma. Usually these ulcers do not persist unless there is an obstruction to the passage of the food through the pylorus, and if this condition exists the excision of an ulcer would hardly result in a permanent cure. Moreover, the establishment of free drainage of the stomach by means of a gastro-enterostomy would result in the healing of such an ulcer. However, there is a class of ulcers which stand on the border line of malignant growths, and in this class an excision of the ulcer and surrounding tissues is certainly indicated. This can be done most safely by lifting up the stomach and making an incision around the ulcer, first through the serous and muscular coats, then grasping all of the vessels with hemostatic forceps and ligating them with fine catgut, then lifting the wall of the stomach so as to have the wound extend at right angles with the long axis of the stomach. The mucous membrane may now be sutured without first cutting it, or it may be cut and then sutured with a continuous catgut or silk suture, the first row grasping only the muscular and mucous layers. Over this a continuous Lembert suture is applied. This suture grasps all of the layers down to the mucous membrane, but not through it. By applying this row of sutures transversely to the axis of the stomach one avoids the tendency of narrowing the lumen of the pylorus in case the ulcer is near the pyloric end.

The excision of an ulcer should not prevent the surgeon from making a gastro-enterostomy if this is otherwise indicated, but a portion of the stomach must be selected sufficiently distant from the location of the ulcer to insure satisfactory healing. Of course, the same precautions should be taken in making gastro-enterostomies in these cases as in all others.

In cases in which a chronic ulcer of the stomach co-exists with a stenosis of the pylorus sufficiently small to indicate a gastro-enterostomy, it is doubtful whether an excision of the ulcer is ever indicated, because the gastro-enterostomy will be followed by a perfect drainage of the stomach, and this by the permanent healing of the gastric ulcer.

Rodman has suggested that in ulcer of the pyloric end of the stomach the pyloric end be excised entirely to a sufficient distance beyond the ulcer to include what he calls the ulcer-bearing area, and then to make a gastro-en-

terostomy similar to that which has been described. Aside from the fact that this method removes the ulcer radically it has the further advantage of removing the portion of the stomach in which carcinoma is most likely to occur secondarily to the existence of an ulcer.

GASTRO-ENTEROSTOMY AND ENTERO-ENTEROSTOMY WITH THE MCGRAW ELASTIC LIGATURE.

This method has been found very satisfactory in cases in which there is not a complete obstruction of the pylorus. The elastic ligature does not cut its way out for two to four days, so there is no drainage from this source during that time. If the obstruction of the pylorus is complete, there is apt to be an accumulation of fluid in the viscus which cannot pass on until the elastic cord has established a communication between the stomach and the jejunum.

The immediate results have been characterized by an absence of shock and discomfort following the operation and there has been no regurgitant vomiting, vicious circle after gastro-enterostomy, the anterior operation having been employed invariably and the lowest point having been chosen, the anastomosis being made directly above the gastro-epiploic artery.

In gastro-enterostomy the following steps are taken: The abdomen is opened in the usual manner.

Technique.

The transverse colon and the omentum are then drawn out through the incision and the jejunum is located a little to the left of the median line, just where it passes through the mesentery of the colon. By lifting up the colon one can always easily locate this intestine.

It is preferable to make a posterior gastro-enterostomy through a tear in the transverse mesocolon, the beginning of the jejunum being united to the lowest portion of the stomach. The points of anastomosis on the stomach and the jejunum are selected just the same as described in the Mayo-Moynihan operation previously mentioned. The jejunum and stomach are sutured together with a running Lembert stitch for a distance of seven centimeters.

A long needle armed with a McGraw elastic ligature is then passed into the lumen of the intestine, as in Plate LXXXI, so that its points of entrance and exit are one-half cm. within the line of sutures at each end. The point of the needle is grasped with forceps, then the elastic ligature is stretched in order to decrease its caliber so that it will thoroughly fill the needle holes in the intestine when it is relaxed after being drawn through. The same step is reversed in the stomach. A strong silk ligature is then placed between the two free ends of the elastic ligature, which are then tied in a half knot, as in Plate LXXXII. While these ends are drawn very tightly the silk ligature is tied down upon them where they are crossed. It is well to tie a triple knot in the silk ligature to insure against slipping. When the elastic ligature is relaxed it forms a little enlargement beyond the ligature on each side. The ends are cut two mm. beyond the silk ligature. Then the continuous silk suture is completed in front of the elastic ligature so that the latter is completely buried; it is important to apply this suture accurately in order to prevent any leakage when the elastic ligature begins to cut its way through.

The accompanying illustrations are taken directly from Dr. McGraw's

original drawings. They represent an enterostomy, but the principle is precisely the same and it is not difficult to imagine the operation changed to a gastro-enterostomy.

In order to avoid error in performing this operation it may be well to recapitulate the steps:

1. A round rubber cord 2 mm. in diameter, made of the best material should be used.
 2. A posterior row of Lembert sutures is applied.
 3. A long, straight needle armed with the rubber ligature is passed into the lumen of the intestine and out again at the desired distance, from 5 to 10 cm. away from the point of introduction.
 4. While an assistant holds the intestine the surgeon stretches the rubber in the needle and when quite taut draws it rapidly through the intestine.
 5. The same step is repeated through the stomach.
 6. A strong silk ligature is placed across and underneath the rubber ligature between the latter and the point where the stomach and intestine come together.
 7. A single tie is made in the rubber ligature after the latter has been drawn very tightly.
 8. The silk ligature is passed around the ends of the rubber ligature where they cross, and tied securely three times.
 9. The ends of the latter are released and cut off, being held by the silk ligature.
 10. The Lembert suture is continued around in front until the point of its beginning is reached, where it will be tied.
 11. Care must be exercised to prevent tying the rubber ligature too far backward and thus getting behind the posterior row of Lembert sutures.
- We are thus explicit in describing the steps of this operation because we find that only those who are thoroughly familiar with the method have used it, and apparently all with great satisfaction.

CARCINOMA OF THE STOMACH.

Importance of Early Diagnosis.

The surgical treatment of cancer of the stomach has received a great deal of attention during the past few years. The technique of resection of the stomach for carcinoma has reached the same degree of perfection as that connected with the surgical treatment of other abdominal conditions, and the percentage of five-year cures, especially in early cases, compares very favorably with the results in surgical treatment of cancer in other portions of the body, as for instance cancer of breast and uterus. The important point in the surgical treatment of carcinoma of the stomach is to be able to make an early diagnosis. As soon as the diagnosis is made, or it is even strongly suspected to be a case of carcinoma of the stomach, the person becomes a surgical patient and should be subjected to at least an exploratory incision.

Typical Case.

The patient is a married woman, thirty-five years of age, giving the following history: Her family history is negative. She suffered from measles as a child, menstruated at seventeen, regularly, but painful, before the time of her marriage at the age of twenty-eight. One year later she had



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PLATE LXXXI
ENTEROSTOMY WITH MCGRAW ELASTIC LIGATURE

The primary Lembert suture in place. The elastic ligature has been inserted but not tied.
(From Dr. J. O. Walker's original drawings of Prof. Theodor McGraw's operation.)



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PLATE LXXXII

ENTEROSTOMY WITH MCGRAW ELASTIC LIGATURE.

Showing posterior Lembert suture, elastic ligature in place with first loop ready to be

(From Dr. H. O. Walker's original drawings of Prof. Theodor McGraw's operation.)



PLATE LXXXIII

ENTEROSTOMY WITH MCGRAW ELASTIC LIGATURE

The primary Lembert suture in place. The elastic ligature has been tied but the ends have not yet been cut short. The suture securing the tied ends of the elastic ligature has been tied but the ends have not been cut short.
 (From Dr. H. O. Walker's original drawings of Prof. Theodor McGraw's operation.)



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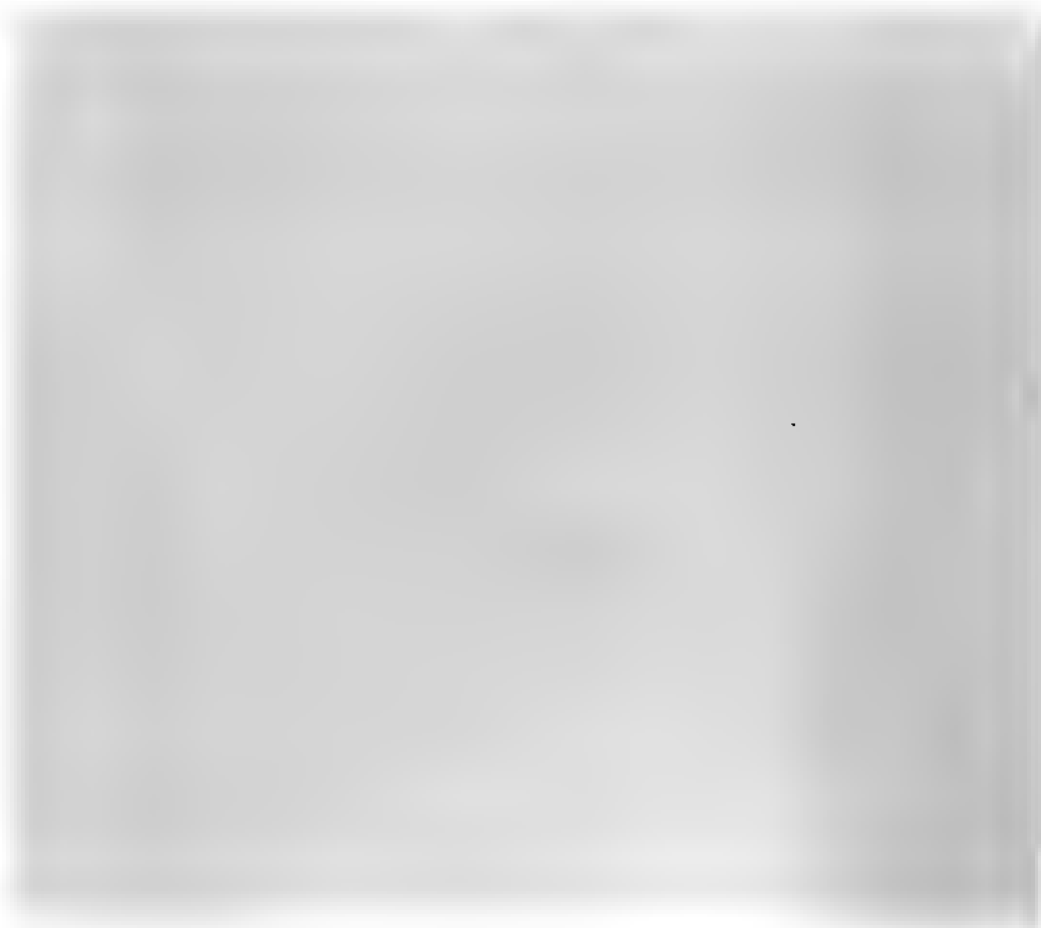
PLATE LXXXIV

ENTEROSTOMY WITH MCGRAW ELASTIC LIGATURE

Operation Completed

(From Dr. H. O. Walker's original drawings of Prof. Theodor McGraw's operation.)

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a miscarriage, but has otherwise been in good health. Five months ago, patient began to suffer from acid stomach and from the presence of a feeling of fullness after eating, accompanied by eructations of gas. She has also suffered severely from constipation. For the past two months she has vomited, usually after taking solid food, occasionally, however, she would retain any kind of food in her stomach for two or three days and then vomit all that she had taken during this period of time. She has not suffered any pain and her temperature has been normal. She has occasionally been slightly jaundiced. The patient has never been very well nourished.

Present Condition.

The patient is quite emaciated, being fifteen pounds below her usual weight; her tongue is coated and she is very hungry; her bowels are constipated. Cathartics give rise to nausea. Temperature is 98° F., the pulse 86, regular and fairly strong. Heart, lungs and kidneys are normal. The abdomen is distended, but not tender upon pressure. There is no free fluid in the peritoneal cavity. The stomach is prolapsed and distended, the lower border extends two inches below the umbilicus. Succussion sounds are marked upon shaking the abdomen. A hard, elliptical body, movable with respiration can be felt in the right hypochondriac region. There is a tympanitic space between this mass and the costal arch. The mass is movable in every direction.

Diagnosis.

This history would indicate beyond a doubt that there exists in this case an obstruction of the pyloric end of the stomach. This may be due to the presence of a malignant growth corresponding to the tumor, which can easily be demonstrated, or it may be due to a non-malignant stricture of the pylorus, or to a short bend in this part of the alimentary canal. The tumor is farther to the right than we usually find a carcinoma of the pylorus and it might readily be a distended gall bladder or even a tumor of this organ, or it might be a movable kidney containing a small tumor. The youth of the patient might be considered an argument against the diagnosis of carcinoma of the pylorus.

Notwithstanding these facts, there can scarcely be a doubt but that this patient is suffering from the presence of a carcinoma obstructing the pylorus, because the history and the findings upon physical examination—hyperacidity, pain, hemorrhage, dilatation, emaciation, and tumor—are very characteristic in this case.

Indications for Operation.

Judging from the size of the tumor and the amount of obstruction present, it is not at all likely that an operation will result in the removal of the malignant growth, or in case a removal is accomplished it is not at all probable that this will result in a radical cure. Consequently the best that can be expected from an operation is simply a certain degree of temporary relief. This relief will consist in the establishment of a free communication between the stomach and the small intestine. As a result of this the nausea, vomiting and pain will rapidly disappear, the nutrition will improve and the patient will no longer absorb decomposition products from the stomach. Her cachexia will consequently disappear, she will gain in weight and strength and will imagine herself quite well for a time.

Sooner or later the carcinoma will have involved so great a portion of

the stomach and the surrounding organs that she will succumb to the disease, but it may be a considerable time before this is to be expected.

Preparatory Treatment.

Gastric lavage will be performed night and morning for one or two days until the stomach contents no longer have an offensive odor. The morning of the day before the operation two ounces of castor oil will be introduced through the stomach tube, after the gastric lavage has been completed. In the meantime some aseptic predigested food will be given every three hours.

Should the oil not produce a very free evacuation of the bowels, the same dose will be given in the same manner every twelve hours until the desired effect has been accomplished. If the oil is not retained in the stomach free evacuation of the bowels will be accomplished if possible by means of enemata. On the morning before the operation the stomach will again be thoroughly cleansed by means of gastric lavage.

Technique.

The incision is made as in the previous case. We find as we had expected, an extensive involvement of the entire pylorus with the tumor extending well up on the lesser curvature. The lymph glands to a considerable distance, especially behind the pylorus and along the lesser and greater curvature of the stomach, are involved. It seems plain that the complete removal of these glands, together with the tumor, is not possible, and a partial removal would only serve to excite a more rapid growth, consequently no benefit could come from an attempt at a radical operation and it would not be wise to make the effort.

The healthy portion of the stomach is greatly dilated on account of the almost complete closure of the pyloric opening. The greater curvature extends more than two inches below the umbilicus. The operation from which the greatest amount of benefit will be derived is a simple gastro-enterostomy.

In planning a gastro-enterostomy for drainage in carcinoma of the stomach, the opening should be chosen at a point quite distant from the carcinoma. In the majority of cases an anterior gastro-enterostomy answers this purpose better than a posterior. The authors frequently use the Murphy button for making the anastomosis, and it will be used in this case.

The jejunum is now brought up out of the abdominal wound and a point selected twelve to sixteen inches from the mesentery of the transverse colon. A small, longitudinal incision is made through the peritoneum and muscular coat down to the mucous coat, then a purse-string stitch is applied, as in Plate LXXXV a. Then the mucous membrane is cut and the larger segment of a Murphy button is inserted and the purse-string suture carefully tied. It is important to apply the purse-string suture close to the edge of the wound in the intestine in order to prevent the tissues being drawn together in irregular masses around the button.

By drawing a small bunch of moist cotton through the hole in the button sufficiently firm to prevent leakage much annoyance may be avoided, because this pledget of cotton can be easily removed before uniting the two lobes of the button. This intestine with the button in place is now surrounded with a piece of moist gauze and placed to one side while the other half of the button is inserted into the stomach in very much the same way.

We have selected the most dependent portion of the greater curvature

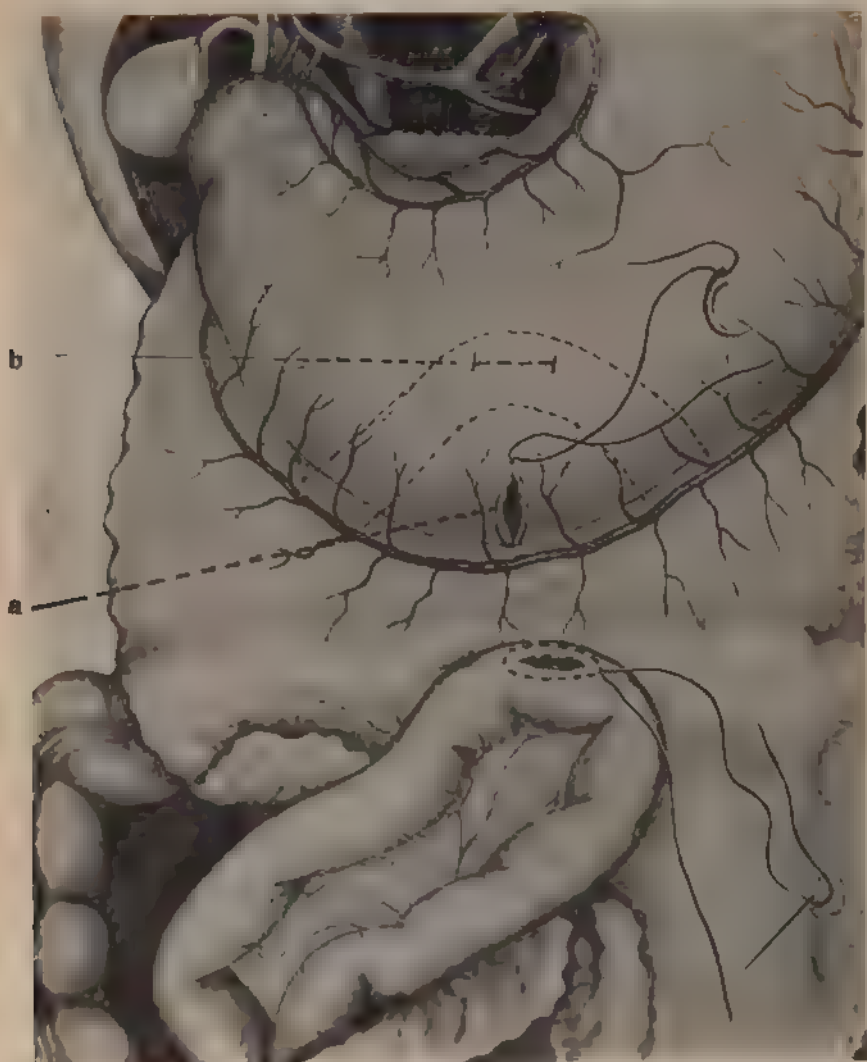


PLATE LXXXV

GASTRO-ENTEROSTOMY

Represents anterior gastro-enterostomy with the sutures in place, both around the incision in the jejunum and the one at the lowest point in the stomach. (a) represents the proper position for uniting the intestine to the stomach. (b) represents the usual position which is wrong, giving rise to vomiting because it forms a pouch into which the contents of the jejunum may empty.

Taken from Dr. W. J. Mayo's original drawing.



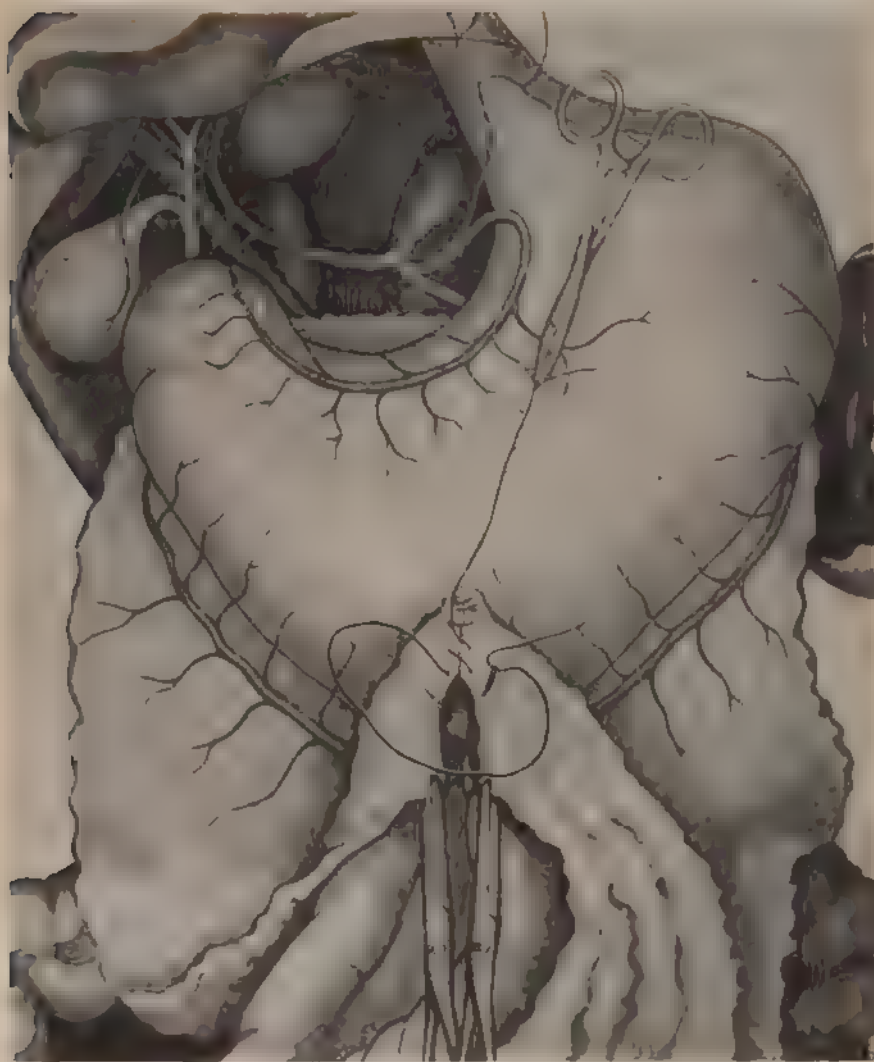
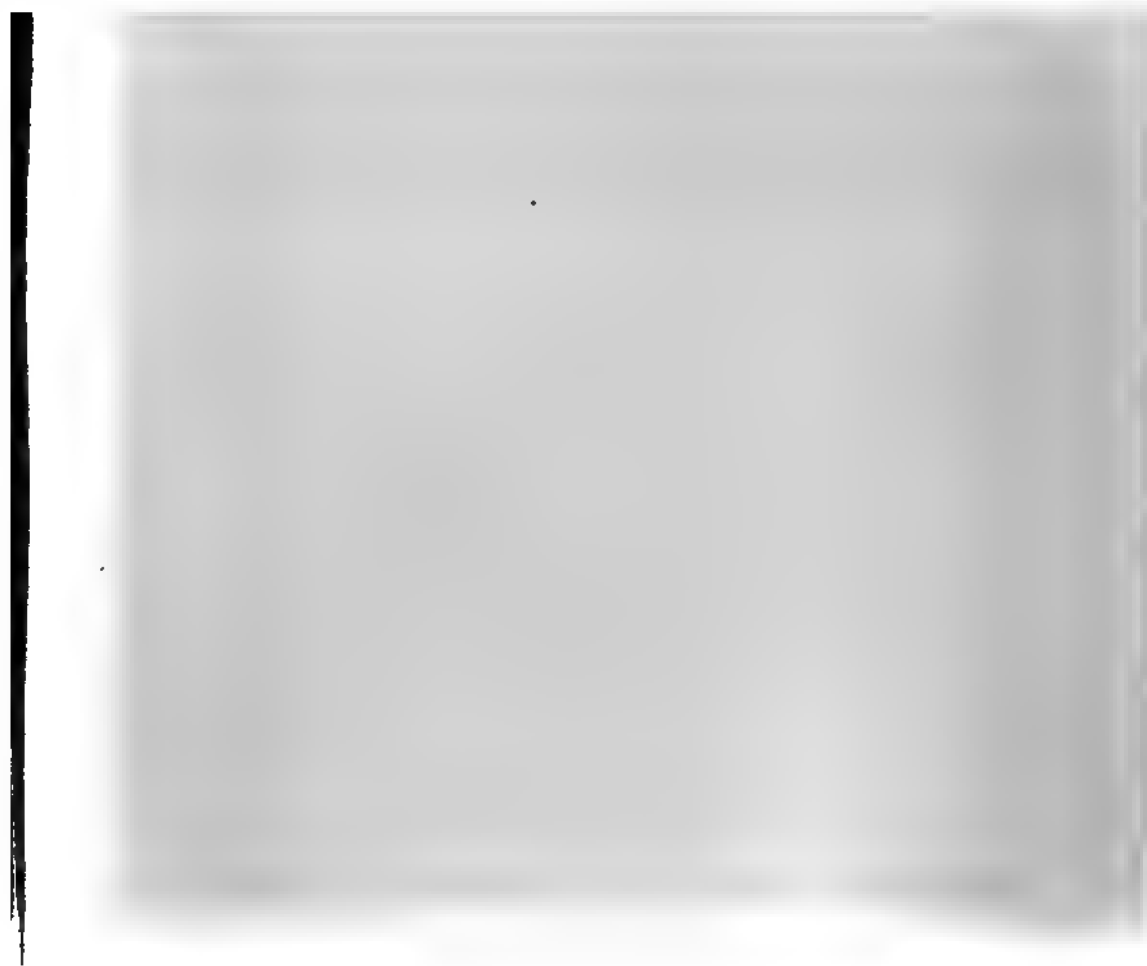


PLATE LXXXVI

GASTRO-ENTEROSTOMY

Represents anterior gastro-enterostomy with the omentum folded over the point of union between the stomach and the jejunum to increase the safety of the operation.
Taken from Dr. W. J. Mayo's original drawing.



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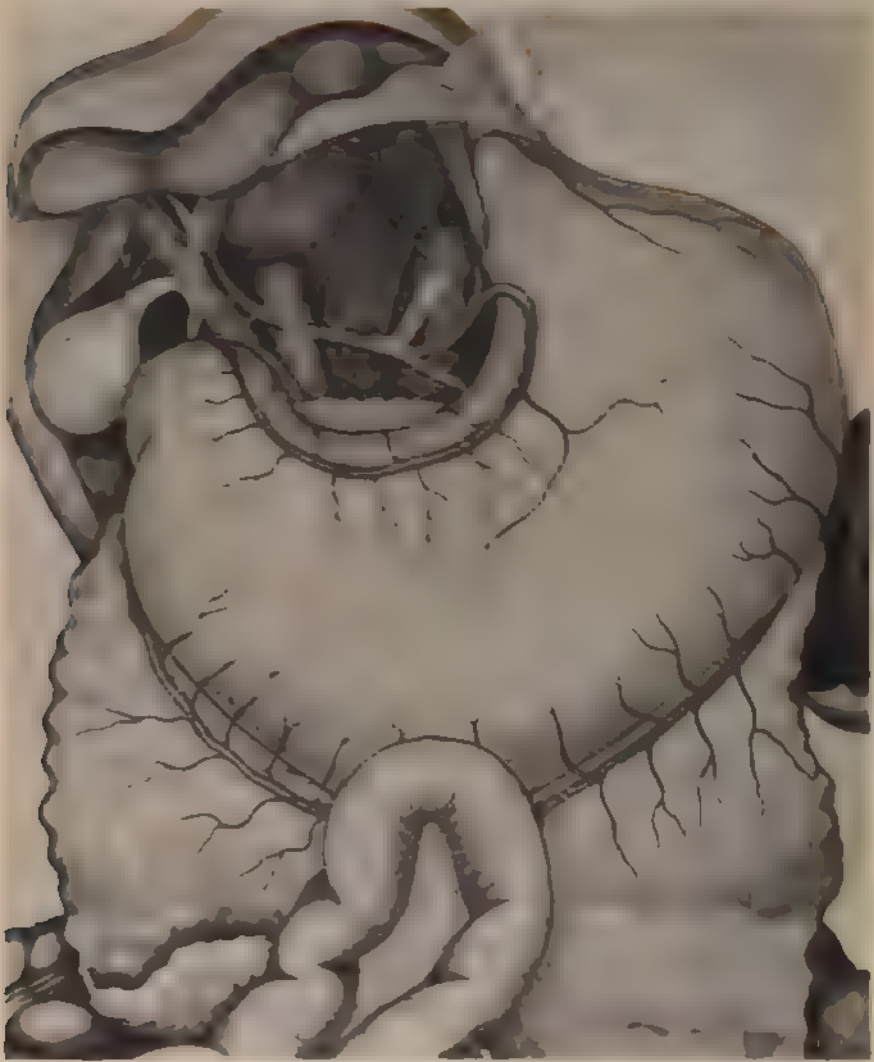


PLATE LXXXVII

LESSER ENTEROSTOMY

Anterior gastric enterostomy. The ~~anastomosis~~ being united to the stomach at its lowest point which will prevent the ~~recurrence~~ of the "Vicious circle."

Taken from Dr. W. J. May's original drawing



of the stomach, but here we find the large artery, the gastro-epiploic, Plate LXXXV b, with its large branches extending at right angles with the greater curvature of the stomach. We will select a point half way between two of these branches and make our incision through the peritoneal and muscular coats down to the mucous coat. The muscular coat will retract somewhat, and here again we exercise the same care in inserting the purse-string suture near the edge of the wound, in order not to draw too much tissue between the rims of the button. The smaller segment of the button is now inserted and the purse-string suture tied. It has been so applied as to avoid having the knots in the two sutures meet when the button has been closed. After withdrawing the pledget of cotton from the opening, the two segments of the button are adjusted to each other and pressed together with a moderate amount of force, care being taken to push in any small portion of serous surface which might not have adjusted itself spontaneously.

In doing the anterior gastro-enterostomy it is wise to add Hartmann's suggestion of stitching the intestine to the stomach wall an inch above the proximal side with a mattress suture. A second suture is placed in same manner about one inch on the distal side of the anastomosis. This prevents the jejunum from kinking on the gastro-jejunal opening.

It is again important to select the lowest point in the stomach, in order to secure perfect drainage of this organ, and especially for the purpose of preventing the flow of bile from the duodenum into the stomach. It is also important to remain as great a distance from the diseased portion of the organ as is compatible with securing the most dependent portion; fortunately, the latter usually lies very well to the left.

In patients who are greatly reduced in strength it is well to reinforce the Murphy button to a certain extent by the use of a cuff formed out of the omentum, as shown in Plate LXXXVI.

It has occasionally happened after a gastro-enterostomy in greatly reduced patients, that a sudden motion, such as would be experienced during a severe paroxysm of coughing, sneezing or vomiting, would be followed by a loosening of the anterior portion of the union between the stomach and the intestine. In these cases it is wise to enforce this union by employing the omentum, which is always well nourished and abundantly supplied with blood vessels, and will consequently make up for the deficiencies in the nutrition of the stomach wall.

Non-operative Cases.

In case an operation is refused by a patient in this condition, we try to secure a degree of comfort by the use of opium. We also teach him to perform gastric lavage whenever he is nauseated. In many of these patients one can secure a great degree of comfort by pursuing the following plan: Gastric lavage is performed in the morning directly before taking breakfast, which should consist as much as possible of food that can be absorbed from the stomach, therefore liquid, in order not to clog whatever slight opening may still exist in the pylorus. Two hours later the remnants of this food are again removed by gastric lavage. The same plan is followed at noon and at night. In this manner the food is not mixed with decomposing mucus and remains from a previous meal, which are partly decomposed and partly digested.

After a short period of practice these patients frequently enjoy this plan, and many of them improve greatly in appearance, because they no longer have to absorb these products of decomposition. It is not infrequent

for patients to gain in weight under this form of treatment, and there is usually a great reduction in pain in cases in which this symptom is marked.

A fear of producing hemorrhage by the use of gastric lavage has been expressed, but we believe that this danger is greatly over-estimated. Before we became familiar with the use of the Murphy button, we had occasion to treat many cases in the manner just described, and never found any difficulty from hemorrhage.

RESECTION OF THE PYLORUS.

Had we encountered a removable tumor of the pylorus in the case above outlined, our treatment would not have varied as regards the communication between the stomach and the intestine, but this would have been preceded by the excision of the pylorus by a method which will be described presently.

There are several valid reasons for preferring a gastro-enterostomy, such as has been described, to a direct end-to-end union between the stomach and the duodenum after the excision of the pylorus: 1. It is much more easily accomplished; 2. The operation requires much less time, which is an important feature in many of these cases; 3. Surfaces completely covered with peritoneum can be united; 4. There is no tension; 5. The adjustment can be made more accurately, because in the end-to-end approximation of the duodenum to the stomach there is a great difference in the lumen which varies with the amount of tissue that has to be removed from the stomach; 6. The attachment being at the most dependent portion of the stomach, the drainage is more likely to be satisfactory.

With the hearty consent of Dr. W. J. Mayo the following extract is used. His work in this field is classical and authoritative. The accompanying illustrations are also taken from his original drawings.

Radical Operations for the Cure of Cancer of the Pyloric End of the Stomach.

[Seventy per cent. of all gastric carcinomata involve the pyloric portion, and sixty per cent. have their origin at the pylorus or within three inches of it. Considering the fact that radical operation was successfully performed in the time of Billroth (1881), before the inception of modern abdominal surgery, and that during the succeeding years more or less work has been done in this field, it is curious that pylorotomy and partial gastrectomy have not as yet achieved an accepted surgical position. There have been a number of reasons for this anomaly; first, a belief that the diagnosis could not be made before the case had advanced beyond the possibility of cure, and, second, that the operation was difficult, prolonged and bloody, with an almost prohibitive mortality. The first proposition is to a considerable extent true; but not entirely so, as we have in exploratory incision the one diagnostic resource which is reliable and which must be resorted to in the large majority of cases before a surgical diagnosis can be made. Without it the truth is but slowly established together with progressive hopeless involvement. Exploration can be safely accomplished through a small incision and with a short time of disability. It is said that the patient will not submit to an abdominal incision upon suspicion. Herein we do the intelligence of the public an injustice; we have seldom been refused the opportunity, when the matter has been fairly and candidly laid before the patient and his friends. The plea for delay has more often come from the attending physician.]

Without going into the question as to the symptoms which would constitute a basis for exploration, the writer would express the opinion that the early diagnosis must be based upon clinical phenomena, the result of observation and experience.

Some Misleading Statements.

In attempting to solve some of these problems we have encountered a number of misleading statements, which seem to have been generally accepted. Of these, three are of sufficient importance to deserve brief discussion: (a) *The value of laboratory methods of diagnosis*; (b) *the significance of a palpable tumor*; (c) *the history of previous ulcer*.

(a) *Laboratory methods of diagnosis* are chiefly based upon the chemistry of the gastric secretions (test meals and so forth) and the microscopical examination and chemical reactions of gastric "findings," as well as the urine, feces and blood. In the surgical stage these examinations have little value, but gain in diagnostic importance with the progress of the disease, to become of the greatest value only when the patient is in a hopeless condition. My colleagues, Drs. Graham and Millet, in the examination of somewhat over 1,500 stomach and duodenal cases, of which 430 came to operative demonstration, showed this beyond question. These examinations should be made, but exploration should not be delayed by reason of the inconclusive nature of the results.

(b) *Tumor*.—The dictum was advanced many years ago that the presence of a tumor of itself demonstrated inoperability. This is by no means true; a small movable tumor in the pyloric region may be a favorable indication. The early diagnosis of cancer depends in a great measure upon the introduction of mechanical phenomena from obstruction at the pylorus, late vomiting, dilatation, pain, gas, etc., with or without palpable tumor, and it is the interference with gastric motility—the progress of food from the stomach—which early calls the attention of the patient to his trouble, and not the presence of the cancer itself. Without these symptoms a surgical diagnosis would seldom be made. In our experience the patient with marked symptoms of cancer of the stomach, but without any evidence of pyloric obstruction, proves on exploration to be the victim of advanced and hopeless disease of the body, in which there were no symptoms during the operable period.

(c) *A history of previous ulcer* with complete recovery during a prolonged period of time is apt to be taken as an indication that a present gastric trouble is due to a recurrence of the ulcer and lead the patient and attendant physician to postpone interference. Usually this is true, but too often the renewal of symptoms is due to cancer development upon an ulcer base. We have had this occur a number of times. The author has become a convert to the belief that cancer frequently develops upon an old ulcer scar. Graham, in 145 cases of cancer of the stomach which came to operation at our hands, found a previous history of ulcer in sixty per cent of the cases, although years may have elapsed after healing of the ulcer before the cancer began. Leheret says that nine per cent of ulcers develop cancer—that is, pass directly from the one condition to the other. Ochsner, Fütterer, Dunn and others believe that the irritation of healed ulcer defects in the mucosa furnish the starting point for the majority of cancers. Murphy rightly says that precancerous lesions can usually be demonstrated in the history of the case. It is to be noted that the topography of cancer and ulcer is nearly identical.

The Determination of Operative Intervention.

The second proposition concerns the operation itself. There are two local manifestations of the malignant process upon which the advisability of operation depends: (a) *Local extent of disease*; (b) *lymphatic involvement*.

(a) *Movability of the growth* is a very important factor in judging of the extent of disease. Limitation to the pyloric end of the stomach is also of prime importance. Extension to neighboring organs usually contraindicates operation, with the occasional exception of the transverse mesocolon. The duodenum is rarely involved to any considerable extent. Adhesions are a serious complication, not only because they are the advance guard of the cancerous process, but in that they add to the difficulties and dangers of the operation. Haberkant found a death rate of seventy-three per cent operated upon in the face of extensive adhesions, and twenty-seven per cent without such complication. Mikulicz had a mortality of seventy per cent when there was close adhesion to the pancreas. A moderate amount of adhesions which permit of free motility of the growth have not materially influenced the prognosis in our experience.

(b) *Lymphatic infection*. This is the most important element in the attempt at cure of cancer of the stomach, because the most difficult to estimate in its extent. The mere presence of enlarged lymph nodes does not necessarily imply cancer. Glandular hyperplasia occurs with great frequency in ulcer as the result of infection, and the location of such lymph nodes may lead to the site of ulceration, as pointed out by Lund. Ulcerating gastric carcinomata may give rise to infected glands without epithelial invasion, but in practically all cases of gastric cancer the lymphatic structures are involved. In the Breslau clinic twenty cases out of twenty-one showed glandular involvement. In a general way the lymph channels follow the blood vessels. On the lesser curvature the blood and lymph vessels lie in the wall of the stomach itself, and, as pointed out by Mikulicz, it is necessary in every case of pyloric cancer to remove all of the lesser curvature to the gastric artery. For convenience this situation on the lesser curvature for beginning of the line of excision may be called the Mikulicz point of election.

To Cuneo we owe a debt of gratitude for his masterly exposition of the lymph drainage of the stomach. He showed that there are but few lymph glands along the greater curvature, and these are confined to the pyloric region. (See Plate LXXXVIII.) These glands, with the blood vessels, lie at some distance from the greater curvature, thus enabling rapid expansion and contraction of the stomach without interference with the circulation. The lymph stream in this situation flows from left to right and does not drain more than one-third of the adjacent stomach, two-thirds going into the lymph channels of the lesser curvature. In the immediate vicinity of the pylorus, however, it drains its fair share.

The lymphatics of the greater and lesser curvatures enter the deep receiving glands about the celiac axis on the anterior surface of the aorta. Cuneo practically demonstrated that the fundus and two-thirds of the greater curvature are free from lymphatic involvement in cancer of the pylorus. Hartmann at once seized upon this basic principle and fixed the point of election for the line of section upon the greater curvature at a healthy place on the gastric wall, to the left of these glands. The distance to the left is regulated by the extent of the disease.

In a previous communication the author called attention to the lymphatic

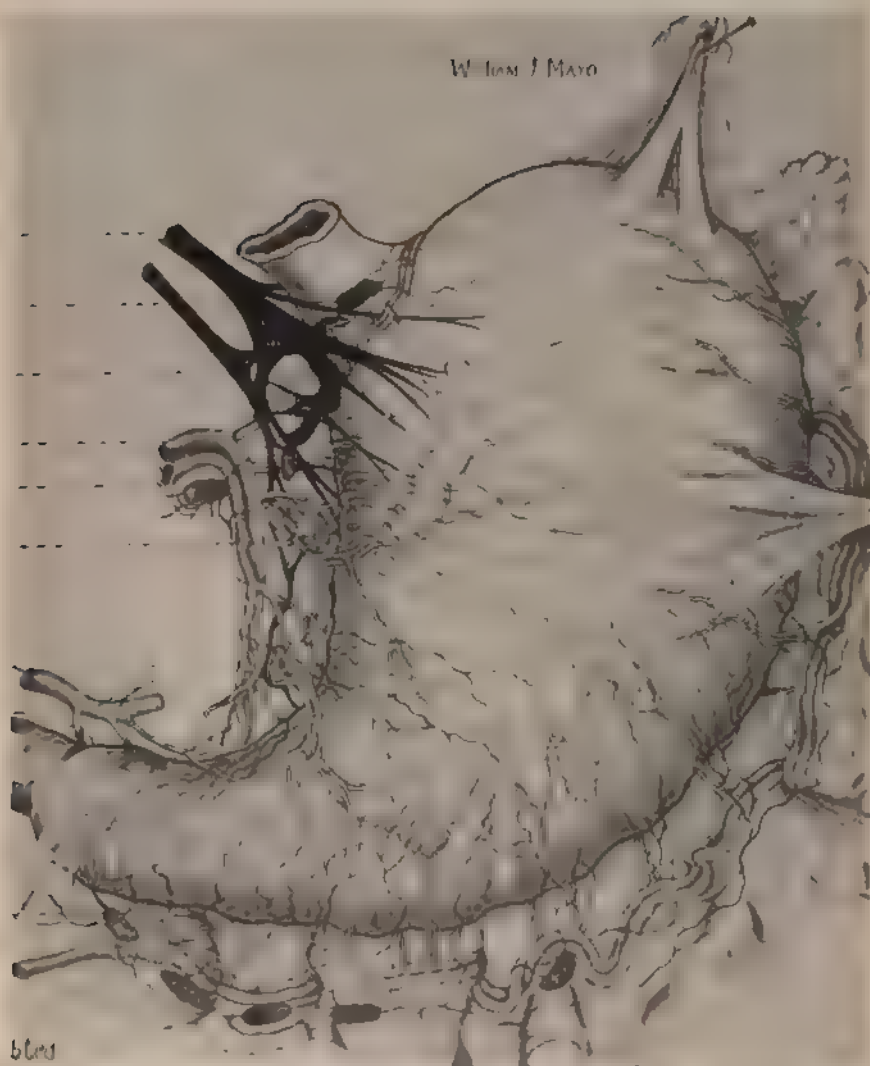


PLATE LXXXVIII
STOMACH SHOWING DISTRIBUTION OF LYMPH NODES
As demonstrated by Hartmann and Cuno
From original drawings of Dr. W. J. Mayo



isolation of the dome of the stomach. This has also been noted by Robson and Moynihan. It is evident that the extent of this free zone along the greater curvature is much wider in pyloric cancer than was at that time considered possible. The retention of this portion of the stomach relieves the operation of many serious difficulties without loss of completeness.

Operative Detail.

The operation itself can be divided into (a) *incision and exposure*; (b) *control of hemorrhage*; (c) *closure of the stomach and duodenal stumps*; (d) *re-establishment of the gastro-intestinal canal*; (e) *avoidance of infection*; (f) *measures for preventing shock*.

The patient's stomach should be cleansed the day before, rather than immediately previous to operation, as it may prove to be somewhat trying to one unaccustomed to the process. A small amount of liquid nourishment may be given after the lavage, but nothing on the morning of the operation. The teeth and mouth should have been previously cleansed as well as possible. A preliminary hypodermatic injection of morphine, to enable the anesthetic to be reduced to a minimum, may be of value.

(A) A small incision is made in the median line, half way between the ensiform cartilage and the umbilicus; through this two fingers are introduced for exploration. If the condition is inoperable, the incision is closed and a sufficient number of buried, non-absorbable mattress sutures of silk, linen or wire introduced into the aponeurotic structure of the linea alba to enable the patient to get about at once and to return to his home and friends within a few days. If sutured in the usual manner and the patient placed in bed for two or three weeks, many of them will develop hypostatic pulmonary lesions, loss of appetite, swelling of the feet and so forth, and may be unable to spend their few remaining days at home. When an advanced cancer case goes to bed for a week or two the chances of his getting about again are small.

Non-absorbable sutures, buried in fixed structures such as fascia and bone, seldom give trouble and furnish immediate strength. In muscle and movable tissues atrophy necrosis may occur. We limit their use, however, to the hopeless cases of exploration for malignant disease. If operation is decided upon, the small exploring incision is rapidly enlarged to four or five inches and a sufficiency of the gastro-hepatic omentum is tied off at once close to the liver. This opens the lesser cavity of the peritoneum and mobilizes the pyloric end of the stomach with tumor. The entire area is now packed off with gauze pads.

(B) Control of hemorrhage. The pyloric end of the stomach is supplied by four blood vessels, the gastric and superior pyloric above, and the right and left gastro-epiploics below. By ligating these four vessels early the operation is rendered practically bloodless. The gastric is doubly tied about one inch below the cardiac orifice at a point where it joins the lesser curvature and divided between the ligatures. The superior pyloric is doubly tied and divided. The fingers are passed beneath the pylorus, raising the gastro-colic omentum from the transverse meso-colon, and in this way safe ligation behind the pylorus of the right gastro-epiploic artery, or in most cases its parent vessel, the gastro-duodenal, is secured. (Plate LXXXIX.) The left gastro-epiploic is now tied at an appropriate point and the necessary amount of gastro-colic omentum doubly tied and cut. Sometimes the right margin of the omentum becomes very much congested from the venous obstruction produced in this way. In a few cases it has seemed wise to

excise the devitalized omentum, especially if drainage is to be used, with its attendant possibilities of secondary infection. In one such case a considerable amount of omentum tissue sloughed, although fortunately the patient recovered. If drainage is not used it will act as an omental graft and give no trouble. It is important that in ligating the gastro-duodenal vessel and the gastro-colic omentum the fingers should raise the structures away from the middle colic artery which runs immediately beneath in the transverse meso-colon. (Plate XC.)

The lesser cavity of the peritoneum is a potential rather than an actual space, as the two layers of peritoneum are in contact, and the middle colic has been accidentally caught in tying the vessels from without inward. As this vessel usually is the entire supply of the transverse colon ligation may result in gangrene of the transverse colon, as pointed out by Kronlein. This has happened a number of times.

The control of hemorrhage is very similar to the ligation of the four vessels concerned in abdominal hysterectomy and fully as easy.

(C) The duodenum is doubly clamped and divided between with the actual cautery to prevent inoculation of the cut surfaces with cancer. (Plate XC.) The stump should be left one-fourth inch long, and before removing the clamp a running suture of catgut is introduced through the seared stump and tied as the clamp is removed. A pursestring suture of silk or linen, three-quarters of an inch below the stump, enables inversion in a similar manner to the stump of the appendix. (Plates XCI and XCII.) A long Kocher clamp is now placed from the tied gastric artery at Mikulicz's point of election, in an oblique direction, so as to save as much as possible of the greater curvature to Hartmann's point of election on the greater curvature. (Plate XCI.) The blades of this clamp should be covered with rubber tubing and the compression should be just sufficient to retain the tissues in its grasp. A second clamp is applied on the tumor side to prevent leakage. The tissues between are severed with the Pacquelin cautery, one-quarter of an inch from the holding clamp, and as the tissues are divided several catch forceps are applied to the projecting stump to prevent retraction of some part of the gastric wall from the grasp of the Kocher clamp. The pyloric end of the stomach, with the tumor guarded against leakage by the clamp at each end, is removed. The cauterized stump projecting beyond the Kocher clamp is rapidly sutured with a catgut button-hole suture, from the greater to the lesser curvature, through all the coats of the stomach, and in the same manner directly back, and tied at the starting point; this prevents hemorrhage as well as leakage. The doubling of this form of suture holds the approximated edges evenly in line. The Kocher clamp is now removed and any bleeding point caught and tied.

The final suture, of silk or linen, is now introduced and made after the right-angled plan of Cushing. It is taken sufficiently far from the catgut suture line to enable easy approximation of the sero-muscular layers without tension. (Plate XCII.)

Steps (d) and (c) can be varied sometimes to advantage. We have frequently tied off the gastro-hepatic ligament and the superior vessels and at once double clamped and divided the duodenum. By pulling upward on the stomach side the gastro-duodenal artery is easily caught, tied and divided, and the operation proceeded with as before. In a few cases we have begun on the stomach side, ligating and dividing the gastric and left gastro-epiploic vessels first, then clamping, dividing and suturing the stomach as



PLATE LXXXIX

STOMACH WITH CARCINOMA OF PYLORUS.

Showing lines chosen in making pylorotomy or partial gastrectomy by various surgeons

(From original drawings of Dr W J Mayo)



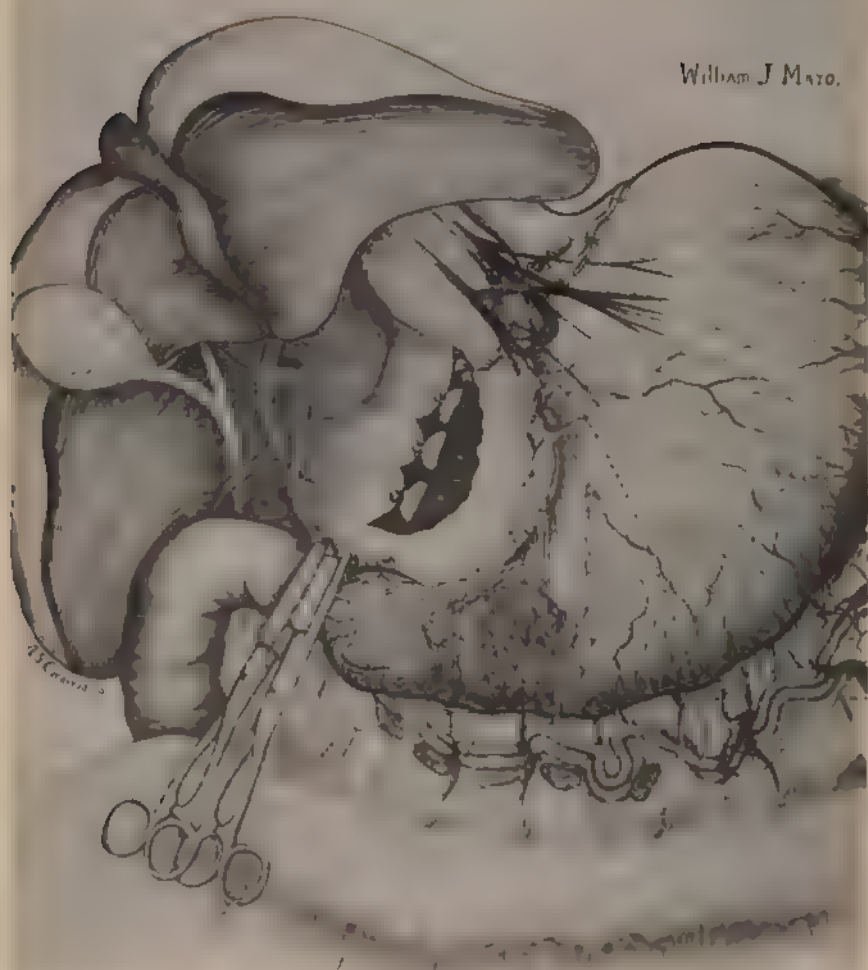


PLATE XC.

STOMACH WITH CARCINOMA OF PYLORUS.

Showing manner of applying forceps to duodenum and also ligation of lesser omentum. Also showing lymph nodes usually involved and line of excision in early cases.

(From original drawing of Dr W J Mayo)



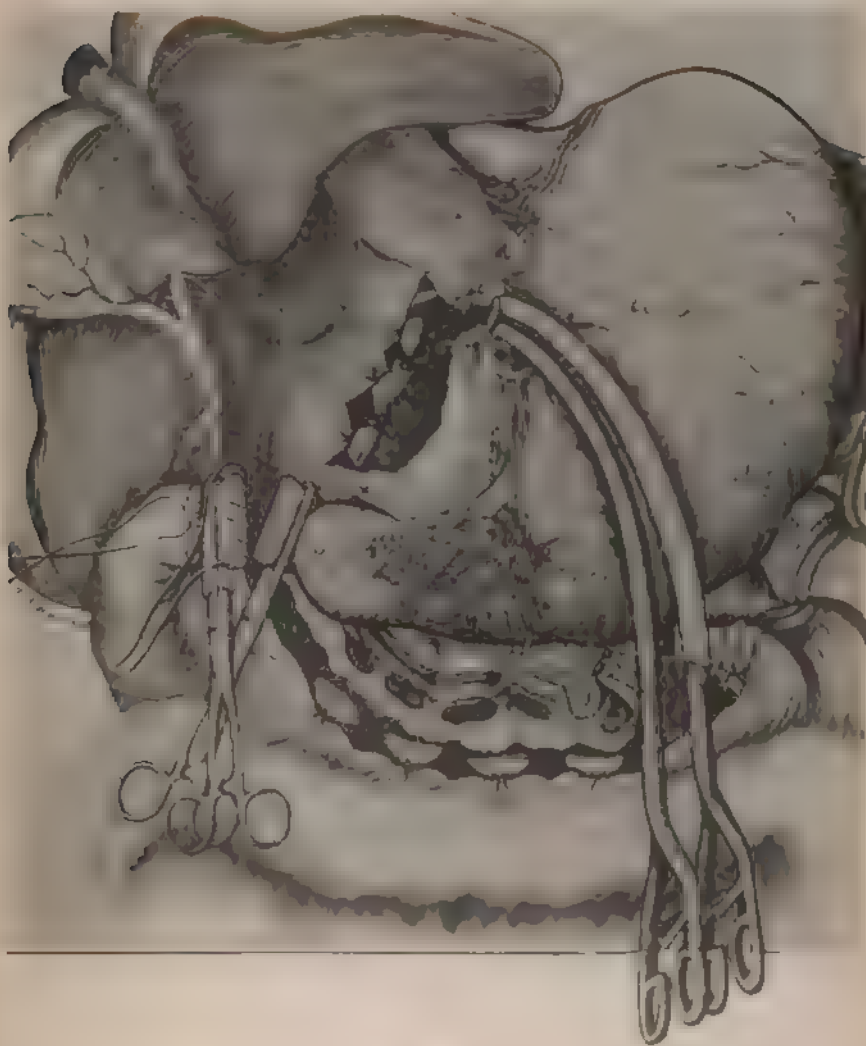


PLATE XXI
PYLORECTOMY WITH PARTIAL GASTRECTOMY

Showing ligation of lesser and greater omentum and application of clamps to duodenum and to stomach. Also center and end anastomosis of duodenum in place.

(From original drawings by Dr. W. J. May.)



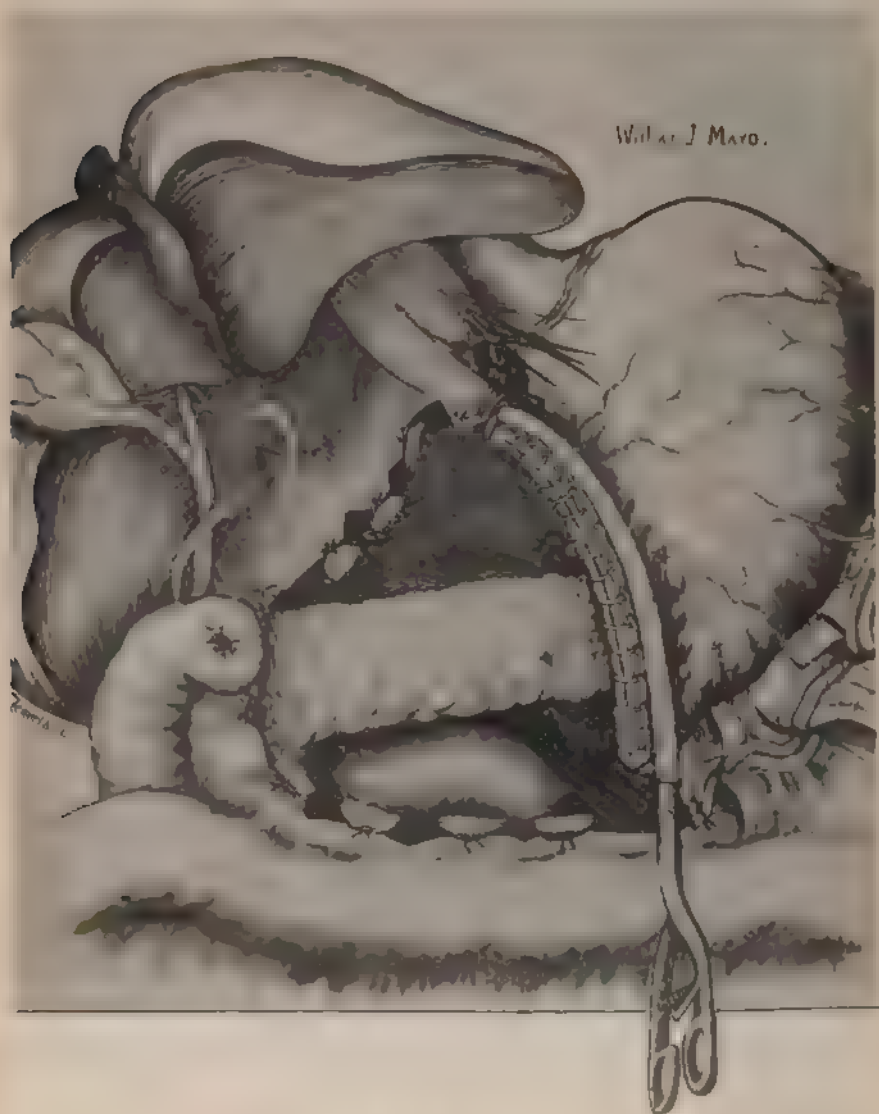


PLATE XCII

PYLOROTOMY WITH PARTIAL GASTRECTOMY FOR CARCINOMA OF PYLORUS

Showing manner of closing end of pylorus and stomach also ligation of all vessels

From Dr. W. J. Mayo's original drawing.





PLATE XCIII

PYLORECTOMY WITH PARTIAL GASTRECTOMY WITH GASTRO JEJUNOSTOMY OPERATION
COMPLETED

(From Dr W J Mayo's original drawing)



before, completing the duodenal end with its vessels last. This is favored by Hartmann. If there are adhesions, however, the first plan mobilizes the stomach much better and enables more accurate work and greater exposure of that part of the stomach, which, at the line of section, lies naturally deep under the costal arch.

(D) Restoration of the gastro-intestinal canal was first accomplished by Billroth, by joining directly the cut surface of the duodenum to the shortened stomach, the opening of the latter viscus being partly sutured to reduce it to the size of the duodenal end. The angle where the three suture lines come together leaked so often, especially if there was the least tension, that it was called the "fatal suture angle." Kocher saw the defect in this method and began implanting the cut end of the duodenum to the posterior gastric wall at a sound point, and completely closed the stomach. This method gives excellent results, if there be no tension in bringing the parts into easy apposition. Unfortunately this often happens.

Billroth's second operation is the operation of choice:—Complete closure of the duodenal and stomach ends with an independent gastro-jejunos-tomy of the usual type. It has the two chief requisites of gastro-intestinal anastomosis; there is no tension and the parts to be united have not been injured. Either the anterior or posterior method can be used and the Murphy button or suture operation be performed. If the patient is in good condition and the operation has been completed promptly, we prefer the posterior suture method; if the patient's condition is poor, the anterior button operation is chosen. (Plate XCIII.)

(E) Infections. The question of cancer infection grafted upon a raw surface is an important one. We have seen carcinomatous nodes develop in the abdominal incision, and in the abdominal needle punctures made in suturing the abdominal wall after partial gastrectomy. Dissemination of carcinoma by rough handling or allowing infected cells to escape into the wound is not uncommon. It is for this reason that all sections of the diseased part are made with the actual cautery, which prevents inoculation of raw surfaces, checks capillary hemorrhage and leaves the approximated ends in an aseptic condition until they are digested back to the outer suture line. Pyogenic infection is prevented by the clamps placed upon each side of the excised stomach, sealing against escape of contents, while the exposed edges beyond the clamp are sterilized by the use of the cautery in making the section. In addition to this the gauze pads are arranged in two rows, an outer, deep layer which is not changed until final removal, and an inner, superficial layer, which is being constantly renewed. Upon removal of the final gauze pack the entire field is carefully gone over and any little bleeding point checked by ligature. After sponging the surfaces with a moist saline gauze pad, the abdominal incision is closed.

In some cases drainage seems wise on account of accidental soiling. This is seldom necessary but if in doubt, drain, and best with a cigarette drain placed at the lower angle of the external wound, entirely away from the visceral suture lines. The internal end of the drain should reach to a situation just above the transverse colon, which acts as a dam when the patient is placed in the proper position in bed—head and shoulders elevated. In this half-sitting posture the little pouch formed by the transverse colon is not unlike an artificial pelvis into which any fluids gravitate. If there be but a limited area to be quarantined, as from slow perforation, the drain should be brought out in the most direct manner possible.

(F) Shock. If the patient is in good condition there is practically no shock because there is no blood loss and little exposure of abdominal contents. The operation proceeds systematically and can be done in a suitable case by the average operator, from the beginning of the abdominal incision until it is closed, in from fifty minutes to one hour and fifteen minutes. If the patient's condition is very poor, owing to early obstruction, the chief danger comes from the lack of fluids in the body. As suggested to us by Dudley Allen, this should be made up by subcutaneous infusions of saline solution, forty to sixty ounces a day, usually twenty to thirty ounces every twelve hours, for two days previous to the operation. This is continued for several days following operation if necessary. In these dehydrated patients it is almost impossible to get sufficient fluids into them in any other manner. For subcutaneous infusions we prefer the ordinary Davidson syringe, to which I attach an aspirating needle. The hand bulb enables nice regulation of the inflow. The whole can be boiled and the infusion given by a nurse as easily as an enema. In debilitated patients very little anesthetic is used, just enough to enable the surgeon to open and close the abdomen. All of the visceral work can be done without pain. The previous exhibition of morphia keeps the patient from becoming nervous.

An enema of six ounces of coffee is given as soon as the patient is put to bed. If necessary morphia, strychnine and so forth are exhibited.

The after-treatment is simple, the head and shoulders of the patient are raised by four or five pillows, rectal alimentation is instituted, hot water by mouth after twelve hours in tablespoonful doses, increased to an ounce every hour. After thirty-six hours the usual experimentation with liquid foods is begun.

To recapitulate, there are six important stages to the operation as outlined:

Step 1.—Open the abdomen.

Step 2.—Double ligate and divide the gastric artery, ligate and divide the necessary amount of gastro-hepatic omentum close to the liver, leaving most of its structure attached to the stomach. Double ligate and divide the superior pyloric artery and free the upper inch or more of the duodenum. (Plate XC.)

Step 3.—With the fingers as a guide underneath the pylorus, in the lesser cavity of the peritoneum, ligate the right gastro-epiploic or gastro-duodenal artery and progressively tie and cut away the gastro-colic omentum distal to the glands and vessels up to the appropriate point on the greater curvature, and here ligate the left gastro-epiploic vessels. (Plate XCI.)

Step 4.—Double clamp the duodenum, divide between with the cautery, leaving one-fourth inch projection. With a running suture of catgut through the seared stump the end of the duodenum is closed as the clamp is removed. A purse-string suture about the duodenum enables the stump to be inverted. (Plate XCII.) The proximal end of the stomach is double-clamped along the Mikulicz-Hartmann line and divided with the cautery, leaving one-fourth inch projection. Suture through the seared stump with a catgut button-hole suture. This is again turned in after removal of the clamp by a continuous silk or Cushing suture. (Plates XCII and XCIII.)

Step 5.—Independent gastro-jejunostomy. (Plate XCIII.)

Step 6.—Closure of the wound.

[The operation herein described, with a mortality of one in fifteen should be the operation of choice for the average case of fairly early disease of the pyloric region.—W. J. MAYO, A. M., M. D.]



PLATE XCVI.

Showing application of stitches in the gastro-hepatic omentum in Beyer's operation for gastropptosis.



GASTROPTOSIS.

The condition of gastropptosis is rarely found except in a complicated form. It is usually associated with a condition of general enteroptosis in which all of the intra-abdominal organs are more or less prolapsed. Thus, for example, when the patient is in the erect position the liver is below the normal line; the kidneys, especially the right one, are lower than normal; the transverse colon, cecum and small intestines are low down in the abdomen. Several years ago many of these patients were subjected to a gastroenterostomy, in the hopes that gastric drainage might relieve their gastric disturbances, but the results were most unsatisfactory.

Patients suffering from gastropptosis are usually thin and are often tall and nearly always of a nervous temperament. They complain of chronic stomach trouble characterized by discomfort after eating, bloating and eructation of gas. Nausea and vomiting are not uncommon, and usually a stomach splash can be found in the lower portion of abdomen several hours after eating. Constipation is usually present.

The physical sign of gastropptosis can easily be elicited by distending the stomach with air through a stomach tube, or by administering tartaric acid and sodium carbonate in separate doses.

Treatment.

The majority can be greatly benefited by general treatment, such as regulating the bowels; massage of the abdomen; gymnastic exercises to strengthen the abdominal wall; the avoidance of tight lacing; the administration of tonics; giving a simple but nourishing diet. Much benefit may also be derived by supporting the abdominal viscera by the wearing of a well-fitting abdominal support.

Operative Treatment.

Many operations have been devised for holding up the stomach, but that of Beyer seems to be the most satisfactory. He shortens the suspensory ligaments of the stomach without interfering with its normal mobility and no abnormal attachment is made to the abdominal wall. The operation is performed as follows: A median incision is made and the patient placed in the inverted Trendelenburg position, allowing the intestines to settle toward the lower portion of the abdominal cavity. The sutures used should be of some non-absorbable material, as linen or silk. The first suture is introduced, beginning above, in the strong tissue of the attachment of the ligament to the liver, the needle grasping a considerable bite of tissue, then grasps the more delicate portion at short intervals from above downwards until a point just above the gastric vessels is reached at the lesser curvature. Four to six of these sutures are inserted in this manner as shown in illustration. When these sutures are tied the lesser curvature is carried up in contact, or almost in contact, with the under surface of the liver at the attachment of the gastrohepatic ligament, and is fixed in this position.

The principle of this operation is that by placing interrupted sutures from above downward through the gastrohepatic omentum, or gastrohepatic and gastrophrenic ligaments, the normal ligamentary supports of the stomach are shortened and the stomach elevated to its normal position without disturbing the physiologic mobility of the organ. With the elevation of the stomach the ptosis of the transverse colon is somewhat corrected.

After Treatment.

After the operation gastric lavage should be used once or twice a day during the time the patient is in the hospital, and nourishment should be given in the form of concentrated food in small quantities to prevent any gaseous distension of the stomach until the tissues have become firmly fixed. With the stomach in this new position, the condition for normal digestion will be greatly improved, and within a few months the patient's nutrition should be markedly better. Among these patients there are many who suffer from a general neurotic condition, and unless this be due to malnutrition resulting from the gastropexy, the neurotic state will not be much benefited.

PART VII.

SURGERY OF THE GALL BLADDER AND LIVER.

In considering the etiology of gall bladder disease it is important to bear in mind the anatomical relation and the mechanical provisions. So long as the anatomical relations are normal, and the organ is, mechanically considered, approximately perfect, there is no occasion for treatment because the gall bladder becomes distended with bile, which is a non-irritating fluid and is emptied regularly. These functions give rise to neither pain, irritation or discomfort.

Normally the gall bladder is suspended from the under surface of the liver as a very slightly distended, pyriform sac which empties its fluid rapidly into the duodenum. The muscles of the gall bladder are very active and well able to expel the contents.

Etiology.

It seems to have been proven beyond a doubt that this pouch shares the fate of all similarly constructed organs in the body—the stomach, the urinary bladder, the pelvis of the kidney, the vermiform appendix; so long as there is nothing to prevent these organs from emptying their contents they are almost certain to remain normal, but so soon as obstruction occurs, interfering with the natural drainage of the organ, trouble is likely to ensue. In other words, an interference with drainage is sure to cause a certain amount of residual substance which makes the accumulation of bacteria possible, and from this accumulation we must expect injury to the lining of the gall bladder.

In ordinary health it is probable that in the majority of cases the human bile is sterile. The bile remains sterile, however, only as long as it flows unobstructed through the ducts. It has been shown experimentally that as soon as the outward flow of bile has been obstructed by ligature of the common duct, the bile above the obstruction becomes infected.

Bacteria enter the gall bladder chiefly in two ways: 1. Along the common duct from the duodenum. 2. By the blood current, chiefly from the portal vein. The fact that the bacillus coli is the most common bacterial inhabitant of the gall bladder and of gall stones suggests that an intestinal origin is most probable.

The injury that results from the accumulation of bile in the gall bladder may simply be catarrhal at first, but will later become destructive to the mucous membrane, giving rise to ulceration; this in turn will result in cicatricial contraction, and this in further obstruction. In such manner the condition must progress.

In the meantime the mucus and debris in the gall bladder may have

been molded into gall stones by contraction of the gall bladder and thus give rise to another important element. The lining of the gall bladder is now no longer in contact only with the relatively non-irritating bile, but also with these hard bodies, which are often of very irregular form, consequently having sharp angles or projections.

Clinical experience has shown that the above theory is correct, because in most of our cases there has been a distinct interference with drainage of the gall bladder. In many cases this was caused by a drawing down of the viscus by adhesions to the omentum or transverse colon, or both, probably caused by a peritonitis resulting from a perforative appendicitis which the patient had sustained many years before. In other cases there was a pedunculated gall bladder, which has been attributed to the effects of tight lacing, and as in many cases this condition occurred only in women, it seems possible that this view is correct.

It has been found that bacteria, especially the colon bacillus, are present with great regularity in diseased gall bladders and in gall stones. It has been found that a large proportion of gall stone patients previously suffered from typhoid fever, and we have found that more than thirty-five per cent of our cases suffered from acute or chronic appendicitis. It is difficult to determine whether typhoid fever, disease of the gall bladder, and of the appendix in appendicitis, is simply a simultaneous infection or whether the infection of the gall bladder is secondary to the other infections.

In experiments upon animals it has been found that the simple infection of the gall bladder gives rise to no pathological condition, provided there is no obstruction to the biliary or cystic duct. The constant flow of new bile seems to be sufficient to dilute and wash away the infectious material to a sufficient extent to make the infection harmless.

It is quite different as soon as there is an obstruction to the ducts. Where there is residual bile in which micro-organisms can multiply, a pathological condition will ensue which may simply develop into a catarrhal inflammation of the mucous lining of the gall bladder, or it may result in the formation of gall stones, or in a severe inflammation of the gall bladder involving anatomical structures beyond the mucous membrane. In man this obstruction may result from the inflammation of the mucous membrane of the common duct due to an infection from the alimentary canal, or, as we have seen in a number of cases, the gall bladder may be drawn downward by adhesions, causing a short bend in the common duct, or more usually in the cystic duct; or an adhesion between the duodenum, stomach and liver. This condition is often due to a gastric or duodenal ulcer. Again, the gall bladder may be forced down out of its normal position on account of tight lacing, and the mucus and debris, accumulated in the pouch containing residual bile, may be expelled at intervals and may clog the biliary or the common duct, and thus form the obstruction necessary to make the infective material effective. We have repeatedly observed a complete obstruction of the common duct produced in this manner. Moreover, we have observed some of the most violent paroxysms of gall stone colic in cases of this kind.

If this obstruction persists in the presence of infectious material in the gall bladder a suppurative inflammation may ensue and this may result in an empyema of the gall bladder; if the infection is severe, especially if there be present a spasmodic contraction of the gall bladder, the entire mucous lining of the latter may become gangrenous, a condition which we have repeatedly seen in acute cases. This may in turn extend to the other layers of

the gall bladder, resulting in a gangrene of the entire organ, or it may affect only a small portion of the gall bladder. When this is the case, the contraction of the non-affected portion of the gall bladder is likely to cause a perforation at the gangrenous point.

It is of practical importance to know that these spasmodic contractions of the gall bladder correspond with contractions of the stomach and that they will subside when the stomach is at rest, only to recur when this condition of rest in the stomach is interrupted.

Age and sex undoubtedly have some influence upon the formation of gall stones, most often found in middle adult life. In looking over a series of two hundred of our own cases it was found that the average age at the time of operation was forty-six years, and that the average duration of symptoms as given in the histories was six and one-half years. The condition occurred four times oftener in females than in males. The youngest male patient operated upon by the authors was twenty years of age, and the youngest female was ten years old.

Symptoms and Signs of Gall Bladder Disease.

The frequency with which gall stones are overlooked draws our attention to the fact that it will be necessary to change the basis of our diagnosis, because the old plan must continue to result in wrong conclusions.

In studying the histories of a series of gall stone cases it will be found that the early manifestations of the presence of gall stones will practically never be referred by the patient to the region of the gall bladder or bile ducts. The patients refer their trouble to the region of the stomach and not to the liver.

Perhaps the earliest symptom, which has persisted for years, is "indigestion." It is not uncommon for these patients to come to the surgeon with a diagnosis of an attack of indigestion, gastric catarrh, neuralgia of the stomach, spasms, etc.

The symptoms, complications and dangers of gall stones differ greatly according to the location of the stones in the gall bladder, cystic or common ducts.

Gall stones in the gall bladder, in the absence of infection, may produce so little discomfort that they may persist for years without being discovered. As soon as catarrh or some acute infection occurs, or the stone passes from the gall bladder into the cystic duct, there may be a great variety of symptoms, varying from mere spasms, frequently called attacks of "indigestion," to very severe colic, agonizing in character, so severe as to even lead to collapse.

Pain to be distinguished from colic, may be local or referred. The local pain may be dull in character rather diffuse, and exaggerated upon taking food. It is this variety of pain which is apt to be mistaken for that due to disease of the stomach. The dull pain is usually due to some irritation or inflammation of the gall bladder becoming more or less tense by some obstruction to the cystic duct due to an impaction of a stone in the cystic duct in its attempt to escape from the gall bladder, or to an inflammatory state of the gall bladder interfering with the free exit of bile.

An Important Sign.

Tenderness is always present especially on deep pressure. One of the most constant signs of gall bladder disease is the inability of the patient to take a full inspiration when the physician's fingers are placed up under

neath the costal arch in the region of the ninth or tenth ribs. The diaphragm forces the liver down until the sensitive gall bladder reaches the examining fingers when the inspiration suddenly ceases as though it had been shut off.

The pain is frequently more acute than that described above, which means that there is a more marked irritation and inflammation of the gall bladder or its ducts, and perhaps of the surrounding peritoneum.

The pain may be referred to various regions. It frequently radiates to the right subscapular region and occasionally to the left; to the epigastric region or umbilicus; to the front of the chest and neck or down the arm.

Boas has described the existence of an area of referred tenderness which is present in the majority of patients suffering from gall bladder disease.

To demonstrate this area the finger should be pressed against a point to the right of the tenth dorsal spine; then against successive points in lines running horizontally outwards, opposite the other spinous processes. It will then be evident which side, if either, is the more tender.

Colic in gall stone disease is not as common as formerly supposed. We have found that over one-half of our cases have never experienced severe biliary colic.

The colic, when severe, causes the most intense suffering. It comes on suddenly and not infrequently produces a condition of collapse. The patient is cold and yet has profuse sweating.

The location of the pain differs greatly. When the colic is due to a spasm of the gall bladder or cystic duct it is most apt to begin along the right costal margin and radiate to the right subscapular region. When due to spasm of the common duct it is more apt to be located centrally and radiate to the mid-scapular region. It may be epigastric throughout, or may even be situated in the left upper quadrant of the abdomen.

The cause of gall stone colic has been much discussed, yet there seems to be no present agreement upon this subject.

Considering the abruptness with which these colics begin, and the suddenness in their relief, it would seem more probable that the pain was due to a spasm of the gall bladder or its ducts during the attempt at expulsion of a calculus, or of thick bile, sand or mucus. This suddenness with which the pain begins and subsides is certainly incompatible with anything of an inflammatory nature, and can only be explained by a spasm due to the sudden entrance and exit of some foreign body.

It is of practical interest to know that these spasmodic contractions of the gall bladder correspond with the contraction of the stomach and that they will subside when the stomach is at rest, only to recur when this condition of rest in the stomach is interrupted.

We have repeatedly observed that attacks of gall stone colic, which would not subside from the use of as much as one-half to three-quarters of a grain of morphine given hypodermically, stop directly upon irrigating the stomach with very hot water, thus putting the organ at rest, only to have a recurrence the moment any form of food was taken into the stomach giving rise to the normal contraction thereof. In these cases a renewed use of gastric lavage and further abstaining from food, would result in permanent interruption of the spasmodic contraction of the gall bladder. This point is of practical importance, because it not only indicates an efficient means for securing the relief of pain, but also for preventing destruction of gall bladder tissue and possible perforation.

Stomach Symptoms.

Perhaps the most common symptom of gall stone disease is "indigestion." The attacks of indigestion begin with pain in the epigastrium, followed by nausea and finally vomiting, which usually brings relief. The nausea and vomiting are partly reflex in character and partly due to direct irritation.

Other gastric disturbances associated with gall bladder disease are frequently manifested by distress in the epigastric region, described as a feeling of weight or a burning sensation after eating; also gaseous distension of the abdomen. These patients are also usually troubled with eructations of gas after eating. It is not uncommon for these patients to have repeated attacks of nausea and vomiting and attacks of indigestion accompanied by a severe pain in the epigastrium often called gastralgia or neuralgia of the stomach.

After an attack of nausea, vomiting and epigastric pain there is apt to be an interim when the patient is free from stomach symptoms, or has only the milder symptoms of bloating and distress after eating.

There may be a dull pain beginning in the epigastric region and extending around the right side at about the level of the tenth rib, passing to a point near the spine and progressing upwards underneath the right shoulder blade.

Jaundice.

Jaundice, upon which so much stress has been placed in the diagnosis of gall stones, is absent in the greater number of cases. Our experience has been that only a small proportion of cases have ever been severely jaundiced, and in more than one-half of them jaundice has never been observed.

The symptoms in regard to icterus in connection with gall stones has been handed down to successive generations of physicians and the laity so long, that the majority of patients refuse to believe that they could have gall stones and not be jaundiced.

Jaundice in cholelithiasis is due to an impaction of a stone in the common or hepatic ducts, or an infection of these ducts, and occasionally to an impaction of a large stone in the cystic duct pressing upon the common or hepatic ducts.

When jaundice is due to gall stones it is most always preceded by a colic. The colic may come on a few hours or days before the appearance of the jaundice. The yellow tinge as a rule comes on gradually and increases until the obstruction is relieved, and then gradually disappears.

Remittent icterus, slight, or as might be called, incomplete attacks of icterus, occurring as often as once or twice a week, is characteristic of stone in the common duct. Fenger attributed this condition to a floating choledochus-stone. He described this condition as occurring in the following manner: A stone becomes impacted in the common duct, and the accumulation of bile on the proximal or liver side, presses the walls of the duct away from the stone, allowing the bile to pass around the stone. Following this the remittent jaundice is due to a "ball-valve" action of the stone.

When jaundice is due to a carcinoma involving the gall ducts, or from pressure from a growth of the head of the pancreas, the jaundice will appear gradually and without pain. There will be no remission or intermission, but will steadily deepen from day to day until the skin becomes a greenish-yellow color. It is very rare to meet with jaundice of a deep greenish-yellow color, except in the presence of malignant disease.

Fever.

Fever is not ordinarily present early in a simple attack of gall stones. If the attack is prolonged and infection occurs, temperature develops. When the infection is confined entirely to the gall bladder, the rise of temperature is usually not high. Mayo explains this condition by the fact that there are few lymphatic channels in the gall bladder and consequently slow absorption.

Where there is an infection of the ducts there may be rigor accompanying or following the colic, with a very abrupt rise of temperature to its maximum, and then with almost equal rapidity return to normal. These attacks may simulate a malarial infection. Between the attacks of infection the temperature remains practically normal. Persistent fever associated with other gall stone symptoms may mean an empyema, or severe cholecystitis or an extension of the infection to the channels in the liver.

Tumor.

A palpable enlargement of the gall bladder occurs as the result of some obstruction of the cystic duct. This obstruction may be from an impacted stone, a cicatricial contraction of the cystic duct, a twist of the neck of the gall bladder, or from an abnormal growth. It occurs also when there is an obstruction of the common duct caused by some pressure from outside.

An enlarged gall bladder is generally pear-shaped, lies just below the edge of the liver and moves up and down, during the act of respiration, with the liver.

OBSTRUCTION OF THE CYSTIC DUCT.

Obstruction of the cystic duct causes retention of fluid in the gall bladder with a rapid distension thereof behind the obstruction. This fluid consists of mucus if the infection is slight, or of muco-pus if the infection is more severe. The bile that may be in the gall bladder at the time the obstruction occurs, is rapidly absorbed, leaving either the clear mucus or turbid fluid, according to the amount of infection. The distended gall bladder may reach an enormous size and usually becomes palpable. If the inflammatory process be very acute a severe cholecystitis or even gangrene of the gall bladder may result. Associated with this condition a local protective peritonitis usually develops leading to the formation of visceral adhesions.

The early symptoms of impaction of stone in the cystic duct are usually very acute, beginning with a severe colic underneath the right costal arch, and radiating up into the right subscapular region. There is rarely any jaundice accompanying or following the pain. The pain loses its colicky character rather early and there may be only a dull ache or sense of discomfort. If the obstruction becomes chronic and there is little or no infection, a hydrops of the gall bladder develops. If it is associated with infection of any severity, an empyema of the gall bladder is apt to be the result.

All of these symptoms may occur without any evidence of jaundice.

ACUTE CHOLECYSTITIS.

The symptoms found in an acute cholecystitis are similar to those present in the early stage of cholelithiasis. In addition to these there is an enlargement of the gall bladder, often making it palpable and very tender upon pressure. There is often acute, severe pain in the gall bladder which may radiate to the back, chest or abdomen. Associated with the pain and

tenderness there may be a right-sided rigidity which may simulate appendicitis. The history will help in the diagnosis, as it will be found that the pain was originally in the gall bladder region and later became diffused. As a rule the tenderness, pain and rigidity of the abdomen are limited to an area along the costal margin.

CHRONIC CHOLECYSTITIS.

In chronic cholecystitis there is seldom present a definite train of symptoms which would ordinarily direct one's attention to the gall bladder. However, there is usually present a rather constant dull, aching pain in the right hypochondrium, often hardly noticeable. There may be exacerbations of the inflammatory trouble when the pain will be more marked. The principal symptoms will be in the line of digestive disturbances, manifested by sensation of fullness in the epigastrium, more or less bloating and distress coming on during or immediately after eating, accompanied by eructations of gas. It is not uncommon for these patients to complain of "sour" stomach.

Occasionally these cases will suffer from a typical attack of biliary colic from the passage of sand-like material through the gall ducts. It is not uncommon in cases of chronic cholecystitis to find the gall bladder filled with black, thick, sandy bile.

The diagnosis depends upon the various gastric disturbances enumerated above, together with the dull aching or burning pain in the right hypochondrium, and the finding of an area of tenderness in the region of the gall bladder. This tenderness is practically always present and can be elicited by placing the finger-tips underneath the costal arch, and when the abdominal muscles are relaxed, have the patient take a deep full inspiration forcing the gall bladder against the finger-tips.

STONES IN THE COMMON DUCT.

With stones in the common duct it is not uncommon to find a history of frequent attacks of pain which have occurred at variable intervals for years, accompanied by a slight jaundice. Suddenly there will be an attack of severe pain with a rapid and pronounced jaundice. This is the time at which the stone passes into the common duct. If the stone be a small one it may pass on into the intestine and the jaundice entirely clear up in a few days. If the stone becomes impacted in the common duct there will be a complete obstruction to the passage of bile, resulting in severe jaundice and enlargement of the liver.

It is rare to meet with an acute permanent occlusion of the common duct from stone. As soon as the stone becomes impacted, the pressure of the bile causes a dilatation of the duct so that a stone which at first fits tightly will be loose in the duct, allowing the bile to pass around it. We then have a condition, which Fenger described, of the stone acting as a "ball-valve" in the duct, which then gives a characteristic history of chronic common duct stone; frequent attacks of pain occurring once or twice a week, accompanied by slight rigor and temperature of 101° , with or without noticeable jaundice. In practically all of these cases close inspection will reveal the presence of slight icterus.

In many patients with an obstruction of the common duct there is a con-

siderable loss in weight. It is important to bear this point in mind, as a symptom of stone in the common duct. The rapid loss of weight is very apt to suggest a diagnosis of malignant disease.

The jaundice of malignant disease is not accompanied by pain, it steadily increases and does not vary from day to day, as it usually does in common duct stones. When the jaundice is due to some pressure from outside the duct, as a carcinoma of the head of the pancreas, the gall bladder will be distended, while in cases where the obstruction is from a stone within the duct the gall bladder is usually contracted.

Indications for Operation.

So long as the gall stones simply remain in the gall bladder without causing any complications, the harm to the patient is relatively slight. The patient's comfort will be greatly disturbed on account of the disturbances of digestion. The pain will not be extreme and he usually accumulates an abundance of fat, especially in the abdominal walls. It has consequently been held by many authorities that it is not wise to make use of radical measures for the removal of gall stones so long as they do not give rise to any grave disturbances. This undoubtedly would be a proper and reasonable view to take were the danger to the patient approximately the same before and after the occurrence of these complications. This, however, is not the case. Experience has shown us that the mortality in cases which are operated before any serious complications arise is practically nil, while the deaths that happen in the complicated cases undoubtedly might have been saved had the operation been performed before these complications arose.

It was the mortality and complications of delay that placed the early and interval operation for appendicitis on a sound surgical footing. To remove the disease while still in the appendix and avoid the various complications was a logical conclusion. The same reason applies with equal force to the early operation for gall stone disease. Remove the disease while still in the gall bladder.

The complications which are likely to be caused by the presence of gall stones may be chronic in character, taking the form of digestive disturbances and giving rise to almost constant discomfort. This is probably due to the interference of the passage of food through the pylorus into the duodenum, causing dilatation of the stomach.

Again, the patient may be in a slightly septic condition, because there is more or less absorption of the septic material from the infected residual bile, as well as from the products of fermentation in the dilated stomach. These conditions frequently result in chronic invalidism, making it impossible for the patient to follow ordinary occupations and to enjoy life in any way. The constant irritation of the gall bladder, due to the pressure of the gall stones, undoubtedly has much to do with the development of carcinoma in this organ.

In cases of primary carcinoma of the gall bladder, we have always been able to get a history of gall stones dating back many years, and have invariably found these present in the gall bladder in such instances at the time of the operation or autopsy. Aside from these chronic affections gall stones may at any time cause exceedingly grave acute conditions.

Complications and Sequelæ.

These complications are all the result of inflammation and the sequelæ must consequently depend upon the extent to which this develops

We take the following list of complications from Mayo Robson's excellent article on this subject, because its arrangement is most satisfactory:

1. Ileus due to paresis of the bowel, leading to enormous distension of the abdomen and to symptoms and appearances of acute intestinal obstruction, apparently the consequence of the violent pain.
2. Acute intestinal obstruction dependent on
 - (a) Paralysis of gut due to local peritonitis in the neighborhood of the gall bladder.
 - (b) Volvulus of small intestine.
 - (c) Stricture of intestine by adventitious bands, originally produced as a result of gall stones.
 - (d) Impaction of a large gall stone in same part of the intestine after ulcerating its way from the bile channels into the bowels.
3. General hemorrhage, the result of long-continued jaundice, dependent either on gall stones alone, or on cholelithiasis associated with malignant disease or with intestinal pancreatitis.
4. Localized peritonitis, producing adhesions which may then become a source of pain even after the gall stones have been gotten rid of. It is believed that nearly every serious attack of biliary colic is accompanied by adhesive peritonitis, as experience shows that adhesions are found practically in all cases where there have been characteristic seizures.
5. Dilatation of stomach depending upon adhesions around the pylorus.
6. Ulceration of the bile passages, establishing a fistula between them and the intestine.
7. Stricture of the cystic or common duct.
8. Abscess of the liver.
9. Localized peritoneal abscess.
10. Abscess in the abdominal wall.
11. Fistula at the umbilicus, or elsewhere on the surface of the abdomen, discharging mucus, muco-pus, or bile.
12. Empyema of the gall bladder.
13. Infective and suppurative cholangitis.
14. Septicemia or pyemia.
15. Phlegmonous cholecystitis.
16. Gangrene of the gall bladder.
17. Perforative peritonitis due to ulceration through or to rupture of the gall bladder or ducts, leading to extravasation of infected bile into the general peritoneal cavity.
18. Pyelitis on the right side due to a gall stone ulcerating or an abscess of the gall bladder bursting into the pelvis of the kidney.
19. Cancer of the gall bladder or ducts.
20. Subphrenic abscess.
21. Pleurisy or empyema of the right pleura.
22. Pneumonia of lower lobe of right lung.
23. Chronic invalidism or inability to perform any of the ordinary business or social duties of life.
24. Gangrenous or suppurative pancreatitis.
25. Chronic interstitial pancreatitis.
26. Infective endocarditis.
27. Cirrhosis of liver.
28. Appendicitis due to extension of inflammation from the gall bladder or to impaction of a gall stone in the appendix.

Contraindications to Operation.

In disease of the gall bladder there are some definite contraindications to operation which, it is believed, have now been quite thoroughly established by clinical observation.

1. It is ordinarily unwise to operate during the attack of gall stone colic.

2. Severe icterus is a contraindication to a prolonged operation.

3. The same is true of prostration following long-continued suffering.

4. Cases complicated with carcinoma belong to the same class.

5. Patients with ecchymotic spots are almost certain to die if operated.

In all these cases if an operation must be performed it should be limited to drainage of the gall bladder and removal of the stones in this viscus, and all further manipulations should be postponed until the patient is in a better general condition.

Treatment.

Gall stones and severe infections of the bile tracts have come to be looked upon as purely surgical affections. However, it has been our experience that cases with acute exacerbations fare better if the operation is deferred until the acute symptoms have subsided. In any case complicated with an acute inflammatory condition, we believe that the same general principle should be employed in the treatment of this condition as inflammatory processes involving the peritoneum from any other cause. So long as there is no circumscribed accumulation of pus, the treatment must consist in rest. This can be secured most readily by using gastric lavage in order to remove remnants of food or decomposing mucus from the stomach, then prohibiting the use of cathartics and food by mouth.

We desire especially to emphasize the value of securing absolute rest of the stomach by the use of gastric lavage, and then not placing any form of nourishment in the stomach but confining the patient to exclusive rectal alimentation, in the treatment of patients suffering from acute cholecystitis characterized by the presence of severe gall stone colic. We have seen many cases where the pain was excruciating and large doses of morphine given hypodermically failed to give relief, in whom the pain disappeared almost completely without further opiates after the use of gastric lavage. In these cases the pain does not recur unless some form of nourishment is given by mouth; even water often causes recurrence of pain.

It may be difficult to explain this observation, but it is likely that the presence of even a small amount of food or mucus in the stomach will be forced into the duodenum and that when it passes over the entrance of the common duct, it causes a contraction of the gall bladder and this excites the pain.

The use of moist heat in the form of poultices or fomentations, or of cold by means of an ice bag, give the patient great comfort and is undoubtedly beneficial.

Morphia may be given hypodermically if necessary, but so long as neither food nor cathartics are given by mouth the pain usually subsides rapidly and permanently. Nourishment may be supplied by enema not oftener than once in four hours, nor in larger quantities than four ounces at a time. We prefer for this purpose one of the various reliable predigested foods mixed with three ounces of warm normal salt solution. In many cases we give no nourishment solution at all, and instead give con-

tinuous salt solution per rectum by the drop method. Unless the acute condition is complicated by a mechanical obstruction of the intestines, the patient's chances for recovery from the acute attack is far better without than with an operation.

It is necessary to make a definite distinction between intestinal obstruction due to peritonitis and that due to a mechanical condition, such as the impaction of a gall stone. The former is so much more common than the latter that it is only very seldom the latter need be considered. Mechanical obstruction due to impaction of a gall stone is characterized by the sudden onset of symptoms of an acute intestinal obstruction, without the inflammatory symptoms which must be present if it was due to a peritonitis.

When the patient has recovered from his acute attack the further treatment may be conducted medically, which will not cure but may improve his condition very greatly, or surgically which is likely to result in a perfect permanent recovery.

The medical treatment must consist chiefly in the use of large quantities of water, preferably taken hot, and in the use of a diet fairly free from sugar and starch.

We believe, however, that the greatest benefit comes from drinking a great amount of good water and never eating quite enough to satisfy the hunger, and from taking vigorous out-of-door exercise, such as horse-back riding, walking or rowing. Sodium phosphate in doses of one drachm or more, in a large goblet of hot water, half an hour before each meal, and pure olive oil in doses of one-half to four ounces, at bed time, seems to have given relief to patients suffering from gall stones, many of them remaining free from severe attacks for a long period of time by conjoining these remedies with proper diet and exercise.

Whether the relief is due to the fact that in this manner constipation is prevented and elimination facilitated by the large draughts of hot water, or whether there is some special virtue in the remedies, it is difficult to say. That many of the patients are relieved of their gall stone colics upon following this plan of treatment, there can be no doubt.

It is plain, however, that this form of treatment can be of benefit only to a limited number of patients, namely, those in whom there is no impaction of the gall stones in the gall bladder, or in the common or cystic duct, and which are not complicated by serious lesions of any portion of the mucous membrane lining these parts, or with extensive adhesions. Moreover, these patients are apt to have recurrences with one or more of the complications enumerated above. Aside from this there is always the danger of the development of carcinoma as a result of the long-continued irritation.

Of late it has been our practice to advise the removal of stones in all cases, provided the patient's general condition would warrant such an operation, and to carry out the palliative measures as described above only in cases that refused operation.

Technique.

In operations on the gall bladder and especially those upon the bile ducts, considerable advantage may be gained by placing a sand bag at or under the patient's back at or a little above the level of the liver. This will cause the liver to present in the wound and afford easy access to the cystic and common ducts.

For all gall bladder operations, a straight incision made through the

right rectus muscle, near its outer border, is undoubtedly the best, primarily. The upper end of the incision starts at the costal margin and extends downward. The incision is first carried through the skin, superficial and deep fascia down to the muscle fibres.

These should be separated longitudinally, by means of a blunt instrument like the handle of a scalpel, so that none of the fibres shall be cut. The incision is completed by carrying it through the transversalis fascia and the peritoneum. The wound should be long enough to admit the entire hand, as advised by Maurice Richardson. This is important because the next step must consist in a careful palpation of the gall bladder, the cystic, the hepatic and the common ducts. This cannot be done thoroughly without introducing the entire hand.

The pancreas, duodenum and the pylorus should be examined at the same time.

The various incisions used in operations upon the gall tract are illustrated in Figs. 3 and 4.

Should it be found that more room is needed than the rectus incision gives, it may be obtained by carrying the upper end of the incision upwards and inwards, cutting the rectus fibres about one inch from the costal margin which virtually converts our primary rectus incision into one first suggested by Mayo Robson. Or this rectus incision may be converted into the "S" shaped incision as devised by Bevan. It is rare though that there will be need for any other than the straight rectus opening.

CHOLECYSTOTOMY.

Cholecystotomy is the operation of choice for removal of stones from the gall bladder.

Cholecystotomy is further performed for the purpose of establishing drainage of the gall bladder, which is useful in not only relieving irritation of the gall bladder and biliary ducts, but indirectly it seems to drain the liver and the pancreas and as a result of this drainage these organs, when generally enlarged as a result of chronic inflammation or irritation due to faulty drainage, will decrease in size very rapidly.

It is consequently important to determine these conditions before deciding upon the operation to be chosen in any given case. After making the incision, the hand is introduced into the abdominal cavity and the gall bladder is palpated between the finger and thumb. It is then followed downward and inwards and the cystic, hepatic and common ducts are palpated in succession.

Occasionally the gall bladder may be so tense that nothing can be determined concerning the character of its contents, except that whatever the gall bladder may contain it is impossible for this substance to pass on freely into the duodenum, and this, in itself, is the strongest indication for a cholecystotomy. If this condition is found, or if gall stones are discovered in the gall bladder or the cystic duct, but none in the hepatic or common ducts, this operation is plainly indicated.

The examination may have revealed more or less extensive recent or old adhesions between the gall bladder and the surrounding organs.

These adhesions may include the liver, the omentum, the transverse colon, the duodenum, or the stomach and in some instances even the right kidney, or they may include any two or more of these organs.

If they are recent, or if they distort one or more of these organs, it is



PLATE XCVII.

A. B. Trocar for aspirating the fluid from the gall bladder. C. Double scoop for removing gall stones. D. Forceps for removing gall stones. E. Rubber tube used for the hepatic or the common duct.



well to loosen or ligate and cut these adhesions. If they have existed for a long period of time without apparently doing any harm, it is better to leave them undisturbed. It must, however, be borne in mind that undoubtedly the adhesions of the gall bladder frequently draw this down and cause it to become sacculated so that it will contain residual bile, which in turn favors infection of this fluid, and thus the formation of gall stones. It is consequently important to remove any adhesions which seem to show a tendency to cause sacculatation of the gall bladder.

This having been accomplished, soft gauze pads moistened with warm normal salt solution are placed about the gall bladder after the latter has been grasped at its most prominent point with one or two pairs of forceps.

This act of packing away the remaining portion of the peritoneal cavity should be done with the greatest care, to prevent soiling during the following steps of the operation.

A trocar is then plunged into the gall bladder to drain away the bile, pus or mucus, as the case may be, contained in the cavity. The trocar devised by Dr. E. H. Ochsner, is undoubtedly most convenient because with it the gall bladder can be emptied perfectly without the slightest damage of soiling any of the surrounding tissues.

Should the gall bladder be contracted because of the long-continued destructive inflammation, which distinguishes old gall stone cases from obstruction due to malignant growths according to the law of Courvoiser, it might not be necessary to make use of the trocar, because there will be no bile in what is left of the gall bladder. In these cases the most prominent portion of the gall bladder is grasped by the forceps and an incision made through the highest part, which is also the next step after the fluid has been aspirated in the other class of cases.

If there is still a little fluid present, this is absorbed by lightly tamponing the cavity of the gall bladder with a narrow strip of aseptic gauze and withdrawing it. This can be repeated a number of times. A blunt gall stone scoop is now introduced and gently withdrawn, bringing out as many of the stones as can be reached in this manner. Then, while the assistant holds up the gall bladder with hemostatic forceps attached to the edge of the wound, the surgeon's hand is again introduced into the abdominal cavity, and the gall bladder and all its ducts are once more carefully palpated.

If stones are still present, these can be removed with the scoop, guided by the hand in the abdominal cavity. If there are stones in the cystic duct, these can frequently be forced back into the gall bladder by a gentle "milking" motion between the forefinger and thumb. Occasionally this can be aided by the use of a small curette guided by the other hand.

In a few instances it has been possible to transfer to the gall bladder not only stones in the cystic duct but even those in the common and hepatic duct. Great caution must, however, be practised, because less injury is done to the patient by making an incision into these ducts than by severe manipulation in the attempt at removing stones, especially if these are immovable as the result of impaction.

So far, the steps of the operation are agreed upon practically by every one who has had a large experience in the treatment of these cases. But from this point on, authorities of equal ability vary in details of their technique.

Varying Methods.

We have used, at various times, most of the methods that have been

recommended, thinking one might be indicated under certain conditions, while another might be more suitable for a slightly different case, but we are convinced that the special benefits from these various operations are entirely imaginary, and that this is simply a remnant of the pedantry which has been so uniformly a part of our professional work for centuries.

A Proven Simple Technique.

In more than one thousand successive cases we have employed the following simple technique, after being satisfied that all the stones had been removed.

1. The gall bladder is carefully, but gently and loosely, tamponed with a long strip of dry gauze. This serves to prevent hemorrhage from the mucous lining of the gall bladder which is frequently severely congested and often covered with bleeding granulations.

2. The transversalis fascia and the peritoneum of the upper angle of the wound is then sutured to the edge of the gall bladder, one to two cm. back from the edge of the opening. Plate XCVIII shows the gall bladder with the forceps upon its edge and drawn out through the wound, and a catgut stitch being placed which attaches the gall bladder to the peritoneum. The stitch in the gall bladder passes down to, but not through, the mucous lining of the gall bladder.

If the gall bladder is small and shrunken the peritoneum and transversalis are brought down to it at one or two points and a piece of gauze is carried down to the gall bladder, and between the gauze and the surrounding tissue a piece of rubber tissue is placed. Attaching the gall bladder in this manner facilitates drainage, and prevents the gall bladder, later on, from becoming sacculated.

3. The abdominal wall is now closed as illustrated in Plate LX. Two of the fine silk-worm gut sutures are passed through all the tissues down to, but not through, the transversalis fascia; these are left untied until the following rows of catgut sutures have been applied in order to prevent the formation of a ventral hernia, by carefully approximating the following layers; a, peritoneum and transversalis fascia; b, rectus abdominis muscle, aponeurosis of the external and the outer layer of the internal oblique muscle passing in front of the rectus abdominis muscle at this point; d, the skin.

These layers are all approximated by suturing with unchromicized catgut, except the skin, for which horse-hair is used. Now by tying the silk-worm gut sutures the closure of the wound is completed.

4. Some rubber tissue is now stuffed down to the gall bladder, between the edges of the abdominal wall and the gauze tampon, to facilitate the removal, about the fifth day, when a rubber drainage tube is inserted in the gall bladder in its place.

Other Methods.

The other methods which seem equally satisfactory consist in substituting for the gauze tampon in the gall bladder, a simple rubber tube, or a split rubber tube filled with a strip of gauze or a cigarette drain. Any one of these may be fastened in the gall bladder by placing a purse-string suture around the opening, inverting the edges, and then drawing the purse-string just sufficiently tight to prevent leakage.

Still another method consists in applying one of these various forms of drainage, and then simply permitting this to project from the upper



PLATE XCVIII.

CHOLECYSTECTOMY

The wound is held open by means of sharp retractors. The gall bladder is drawn out of the abdominal wound by means of haemostatic forceps, one suture is in place attaching the gall bladder to the peritoneum and transversalis fascia, and a second suture is being applied. The umbilicus should be opposite the lower end of the incision, instead of being opposite its center.

This incision should be three inches nearer the costal arch. It is well to insert the suture on the side of the gall bladder transverse'y in order to grasp and compress the branches of the cystic artery more perfectly. Omitting this precaution may occasionally result in severe haemorrhage.



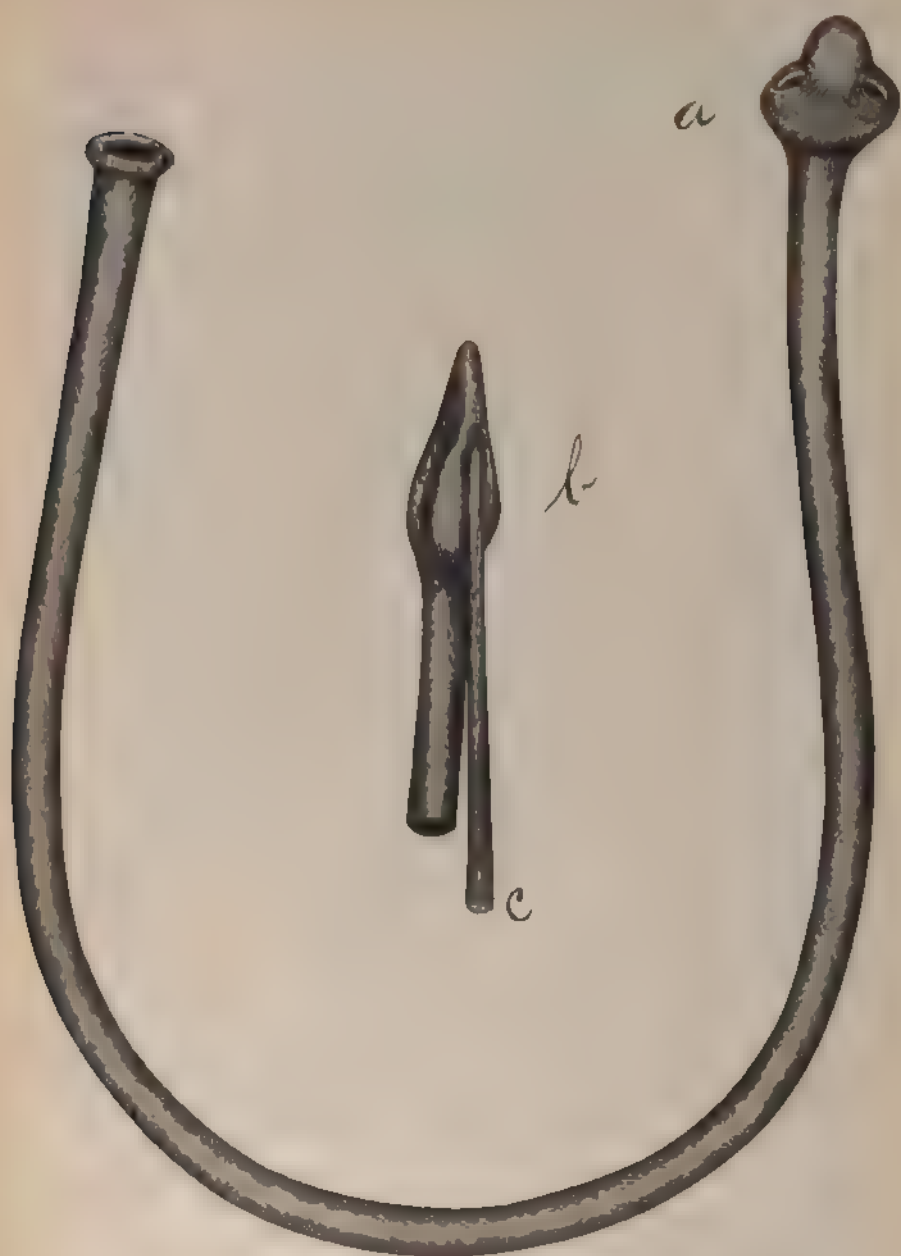


PLATE XCIX.

RETENTION TUBE AFTER THE PLAN OF JACOBS'S RETENTION CATHETER

a shows the bulb-like end in the position it takes when in place. *b* shows the end stretched over a probe *c* in order to reduce its size during its introduction. To be used in draining cavities like the urinary bladder, gall bladder, hydronephric kidney, etc. This tube is also used as a permanent feeding tube in gastrostomy.



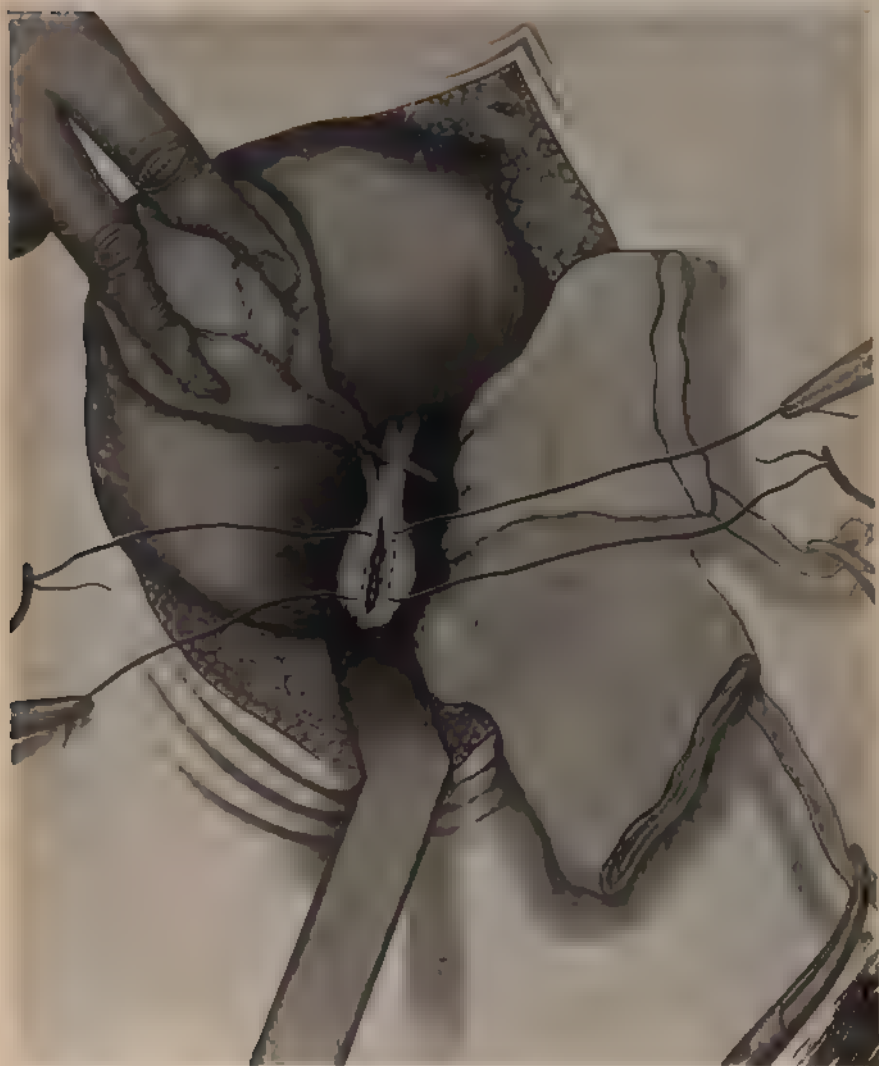


PLATE C.

REMOVAL OF STONE FROM COMMON DUCT AND DRAINAGE OF COMMON DUCT.

Sutures of fine catgut are applied to each side of the proposed incision. These are utilized later to hold in place a rubber drainage tube which is inserted in the incision in the common duct, and also for fastening a piece of gauze which is packed around the tube to further protect the general peritoneal cavity against contamination.

(Taken from Dr W J Mayo's original drawings.)



PLATE CI.

EXCISION OF THE GALL BLADDER

Two pairs of forceps are in place, one grasping the neck of the gall bladder at its entrance into the cystic duct, the other grasping the cystic duct just below this point. Both forceps also grasp the cystic artery. A dotted line indicates the position of a stone in the neck of the gall bladder wedged in and obstructing the latter. The gall bladder is to be removed from below upward, the forceps applied to the neck of the gall bladder, including the cystic artery, making the operation almost bloodless.

(Taken from Dr. W. J. Mayo's original drawings.)

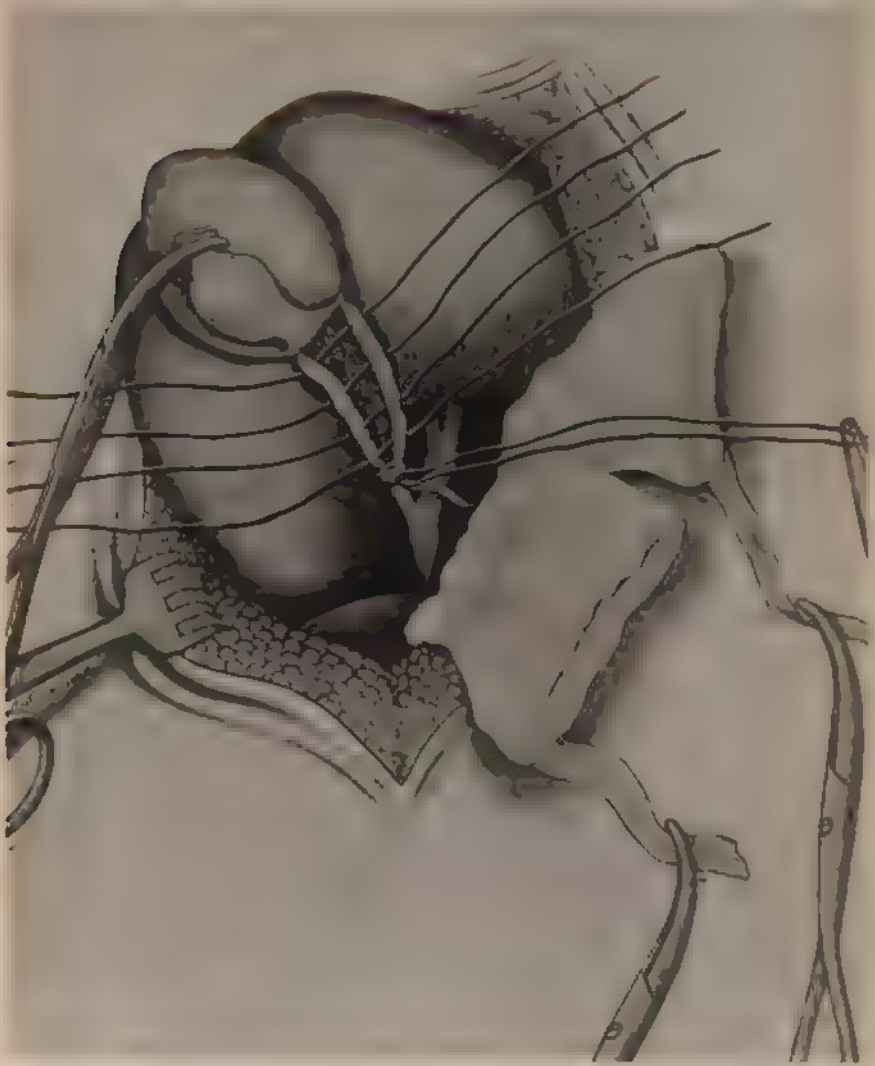
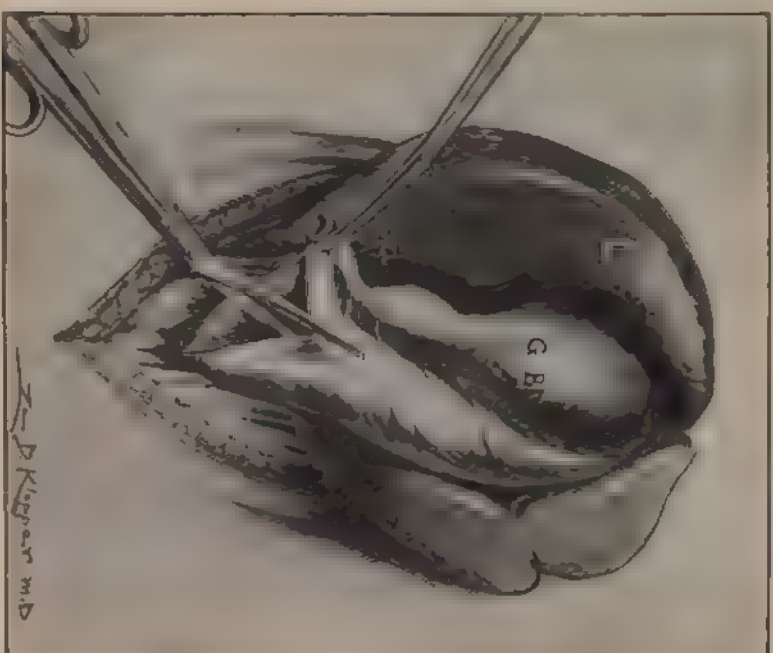


PLATE CII

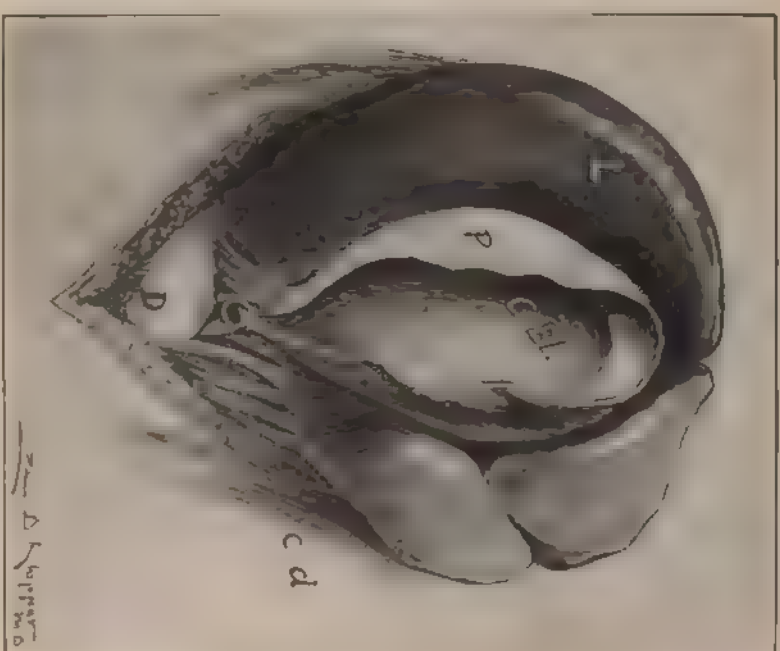
EXCISION OF THE GALL BLADDER BEGINNING FROM BELOW

A ligature has been placed around the cystic duct. The neck of the gall bladder just above the cystic duct is grasped by forceps to prevent leakage. A dotted line indicates the position of a stone wedged into the neck of the gall bladder and causing complete obstruction. The cystic duct and the common duct are also shown. Sutures are in place to close the space formed by the loosening of the gall bladder.

(Taken from Dr. W. J. Mayo's original drawings.)



(a) Shows the cutting of the peritoneal fold between gall bladder and liver in operation of cholecystectomy



(b) Shows where gall bladder and cystic duct have been removed.

PLATE CIII.



(a) Shows where the two edges of the peritoneum have been sutured, covering over the space from which the gall bladder has been removed

PLATE CIV



(b) Shows rubber drainage tube in hepatic duct after the gall bladder has been excised. The hepatic duct is pulled downwards for sake of illustration

angle of the abdominal wound without suturing the gall bladder to the parietal peritoneum. Personally, we have never been favorably impressed by this course.

In case it seems wise to continue the drainage of the gall bladder for a considerable period, the patient can be made more comfortable by inserting a Jacob's retention catheter of proper size into the gall bladder, placing a glass tube in the distal end of this catheter and tying a soft rubber bag to this in order to collect the bile. (Plate XCIX.) Whenever it seems the proper time to interrupt this drainage, the opening will close spontaneously upon withdrawing the catheter.

CHOLECYSTECTOMY.

This operation seems indicated in cases in which there is a permanent obstruction of the cystic duct, which is usually due to a cicatricial contraction of an ulcer, most commonly caused by the impaction of a stone.

It may also be due to the formation of a valve in the neck of the gall bladder at its entrance into the cystic duct. Occasionally such a valve will permit the free flow of bile into the gall bladder, but will not in the opposite direction. The gall bladder should also be removed in cases in which its walls are so thin that it will not be able to act as a contractile organ.

Cholecystectomy should be performed in early cases of primary carcinoma of the gall bladder. In some cases in which the gall bladder has been badly diseased for some time, the disease being limited to the organ alone, and circumstances permit of easy removal, cholecystectomy will be the operation of choice.

The removal of the gall bladder is usually not a difficult matter if it is approached from the right direction. The following simple steps should be followed.

1. The same incision as in cholecystotomy should be made. Occasionally if there are many adhesions, so that it is difficult to reach the lower end of the gall bladder, the incision may be lengthened, according to the plan advised by Bevan, by extending the upper end of the incision inward and the lower end outward; or it may be extended according to Mayo Robson, between the edge of the costal cartilages and the lower end of the sternum, in order that the liver with the gall bladder may be inverted upward.

2. Two pair of hemostatic forceps are then applied, one directly to the cystic duct, grasping at the same time the cystic artery which supplies the gall bladder; the second pair is applied to the neck of the gall bladder at a distance of one cm. from the other. Plate CI shows the two pair of forceps in place. The gall bladder is now cut loose just beyond the second forceps and between this and the first pair, as shown in Plate CII.

3. An incision is now made along the sides of the gall bladder, through its peritoneal covering, about one cm. from its attachment to the liver, and then the organ can be enucleated without difficulty.

If there is any considerable amount of hemorrhage from the surface, a hot tampon of gauze against the surface for a few minutes will control the oozing at once, and then the raw surface can be closed by suturing the two peritoneal folds with catgut as shown in Plate CII.

Plate CIII (a), shows the cutting of the peritoneal fold between the gall bladder and the liver. Plate CIII (b) where the gall bladder and the

cystic duct have been removed. Plate CIV (a) where the two edges of the peritoneum have been sutured covering over the raw surface made by excising the gall bladder. Plate CIV (b) shows rubber drain placed in hepatic duct which is pulled downwards for sake of illustration.

4. Disposition of the stump. If drainage is not desired, a ligature can be placed about the stump of the cystic duct, including the cystic artery, as shown in Plate CII.

If it is doubtful, the artery forceps may be left in place, and may be surrounded by gauze and rubber protective, and permitted to pass out of the upper angle of the wound. This may be loosened after thirty-six hours, or sooner, if it should become apparent that drainage is desired.

It is well in these cases to insert a drainage tube to a point just below the stump for the purpose of providing for an emergency. It is immaterial what form of drainage tube is chosen. In case drainage of the cystic duct is desired, the cystic artery is caught separately at the end of the stump and ligated and a small rubber drainage tube is introduced directly into the common duct through the cystic duct.

Plate XCVII figure (e) shows a drainage tube which is most useful in these cases. A small rubber drainage tube is drawn through a larger tube, the perforated end is introduced into the cystic duct, and it is held in place by one or more catgut sutures, which pass through the outer tube but do not touch the inner tube. By the time the catgut is absorbed, it is time to withdraw the drainage tube.

The abdominal wound is closed as in the previous operation, and the tissues are prevented from adhering to the gauze by the interposition of rubber tissue.

CHOLEDOCHOTOMY.

In operation upon the common duct a sand bag is always placed under the back opposite the liver, as advised by Mayo Robson. The usual straight incision is made through the right rectus muscle. If it is found necessary to open the common duct and more room is desired, the incision is carried upward and inwards between the right costal margin and the ensiform cartilage. Now by lifting the lower edge of the liver out of the wound, it will be found that the gall bladder and the cystic and common ducts will be brought into plain view. The liver is held in this position by an assistant who grasps the lower edge of the liver with his fingers covered with a piece of dry gauze. When the liver is held in this position it will be found that the cystic and common ducts make an almost straight passage from the neck of the gall bladder to the entrance into the duodenum.

If there are adhesions about the ducts, these are separated and a spoon is placed in the kidney pouch and the entire field of operation protected by sterile pads.

The stone is located and grasped between the thumb and finger of the left hand. While the stone is held in this position, two catgut sutures are placed into the side of the common duct directly over the stone. These sutures are left long. A little tension is made upon the sutures, then the duct is opened by making a longitudinal incision between the two sutures directly over the stone.

Plate C illustrates a stone in the common duct, and two catgut sutures applied to each side of the proposed incision and the incision made directly over the stone.



PLATE CV.

Illustrating Mayo Robson's position of the patient during operation upon the common duct

After all obvious stones have been removed, the finger should be passed into the duct to detect any stones that might be above or below the incision.

Any sand or thick bile is removed by packing strips of gauze into the duct in the manner described in sponging out the gall bladder. When the duct is clear, the incision in it may be closed by suture or may be drained. If there is not much evidence of infection of the common duct, and the gall bladder looks healthy and the cystic duct is patent, the wound in the common duct can be closed with safety, leaving drainage of the bile through the gall bladder only. The incision in the duct is closed by first approximating the edges with a fine continuous catgut stitch, and over this a few Lembert stitches of silk. A cigarette drain is placed down to the common duct and brought up out of the incision by the side of the gall bladder drain.

The majority of the cases require drainage of the common duct, especially in those where the head of the pancreas is enlarged from chronic pancreatitis.

A double drainage tube as shown in Plate XCVII figure (e), is inserted into the common duct and carried upwards towards the hepatic duct. The two catgut sutures which were placed in the sides of the duct are now utilized to fasten the drainage tube in place, which is done by passing the sutures through the outer rubber tube and tying. These sutures are still left long.

Now a piece of iodoform gauze is packed around the tube and brought up out of the wound by the side of the drainage tube to further protect the peritoneal cavity. These same sutures are now passed through the gauze and tied so that there can be no displacement of the gauze should the patient vomit after the operation.

The operation is completed by closing the wound in the usual manner.

CHOLECYSTENTEROSTOMY.

This operation is indicated in cases in which there is a permanent obstruction between the entrance of the hepatic duct into the common duct and the opening of the latter into the duodenum, also in cases of chronic interstitial pancreatitis.

The entire alimentary canal should be thoroughly emptied before the operation is undertaken, by the administration of two large doses of castor oil, twelve to twenty-four hours apart, then a careful anastomosis from one-half to one inch in length should be made by any one of the various methods employed in making intestinal anastomosis with needle and thread.

If a mechanical device is employed, the small Murphy button should be chosen, but the suture seems to be a superior method.

After Treatment.

When the operation is completed a dry sterile gauze dressing is applied and held in place by an abdominal bandage applied tightly, so that if vomiting should occur, the wound will receive some support from the bandage.

No water is allowed by mouth until the other sickness and the nausea are over. If the thirst is great the mouth may be flushed frequently with water and an enema of a pint of salt solution may be given.

If the pain is severe, morphia in doses of $\frac{1}{8}$ to $\frac{1}{4}$ of a grain may be given hypodermically.

Four to eight ounces of normal salt solution are given as an enema

every four hours for the first twenty-four hours. Then nourishing enemata in the form of liquid peptonoids, one ounce, with normal salt solution four ounces, are administered every four hours, for two or three days.

As soon as the sickness from the anæsthetic is over, small quantities of water may be given by mouth, and on the third or fourth day beef tea or broth may be allowed increasing the diet slowly from this time on.

The wound is dressed daily with dry sterile gauze, and on the fourth day the gauze is removed from the gall bladder and a rubber tube substituted, which in ordinary cases is removed at the end of a week or ten days, and the wound allowed to close.

In cases accompanied with pancreatitis or a marked cholangitis, the drainage is continued for a period of from two or four weeks.

The stitches are removed on the twelfth day and the patient allowed to get up at the end of fourteen to eighteen days.

Constriction of the Duodenum Below the Entrance of the Common Duct.

Several years ago our attention was first directed to an interesting condition which is frequently present in patients who come under observation during gall-bladder and stomach operations.

In many of these cases the duodenum is distended with gas to a point just below the entrance of the common duct, while below this it is contracted, and upon raising the transverse colon and finding the origin of the jejunum, this portion of the intestine will also be found contracted. In looking over authorities upon the subject of anatomy, we found that they all state that the third portion of the duodenum is the narrowest part of this intestine if they make any statement upon the subject. They also state that the first portion of the duodenum is usually found stained with bile after death. Several further clinical observations pointed in the same direction. It was found that the dilatation of the upper portion of the duodenum was most commonly present in patients suffering from chronic cholecystitis with sand or gallstones in the gall-bladder. In these cases there was frequently a more or less marked enlargement of the pancreas.

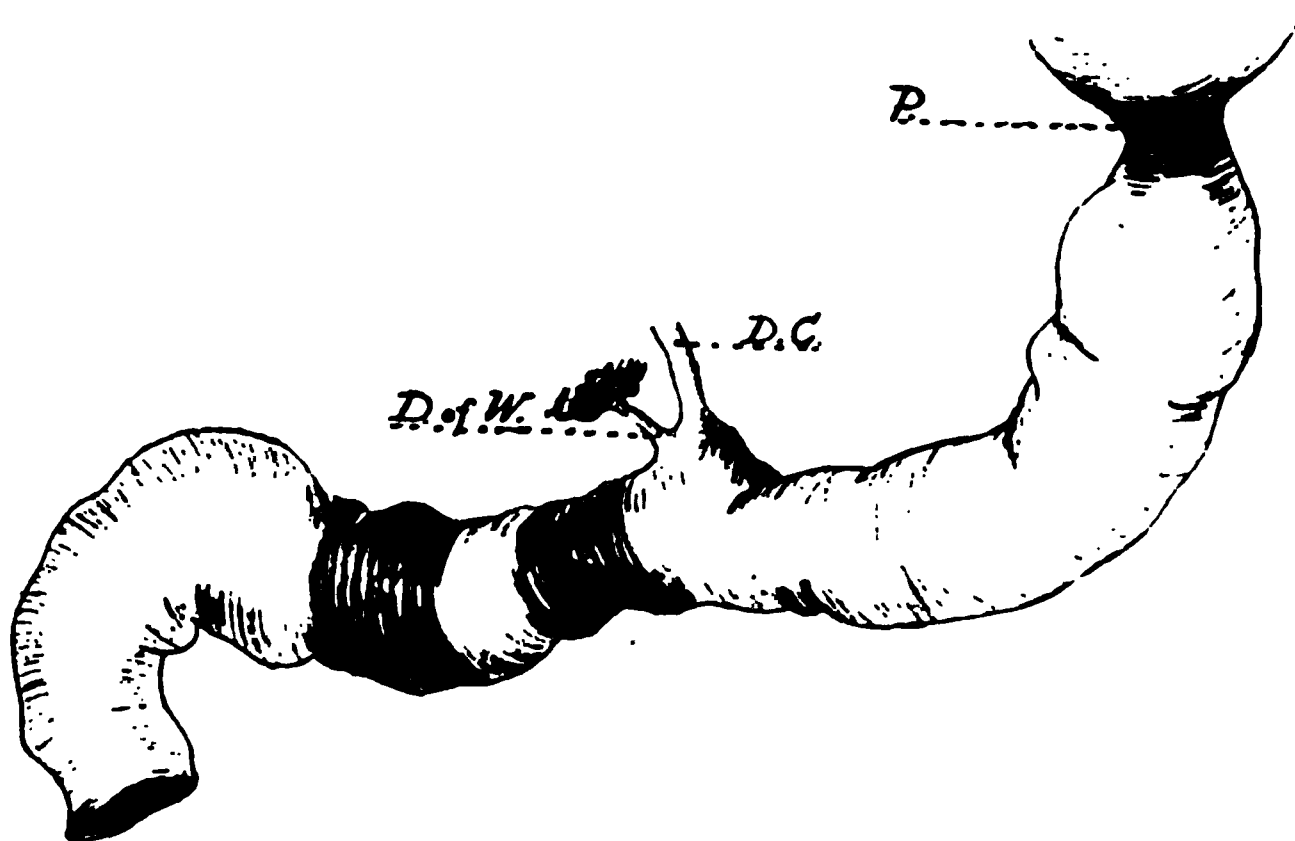
In having the vomitus examined systematically for a considerable period of time in patients who had been subjected to general anesthesia for operation, it was found that it invariably contained bile, showing that there must be some reason why this fluid should be forced upward past the pyloric sphincter rather than downward through the small intestine.

Again, it was found that in patients suffering from acute gall-stone colic, the spasmodic pain would subside invariably within a few hours upon making careful gastric lavage and prohibiting the introduction of any kind of food into the stomach, although without this aid large doses of morphine, given hypodermically, had given at best only temporary relief.

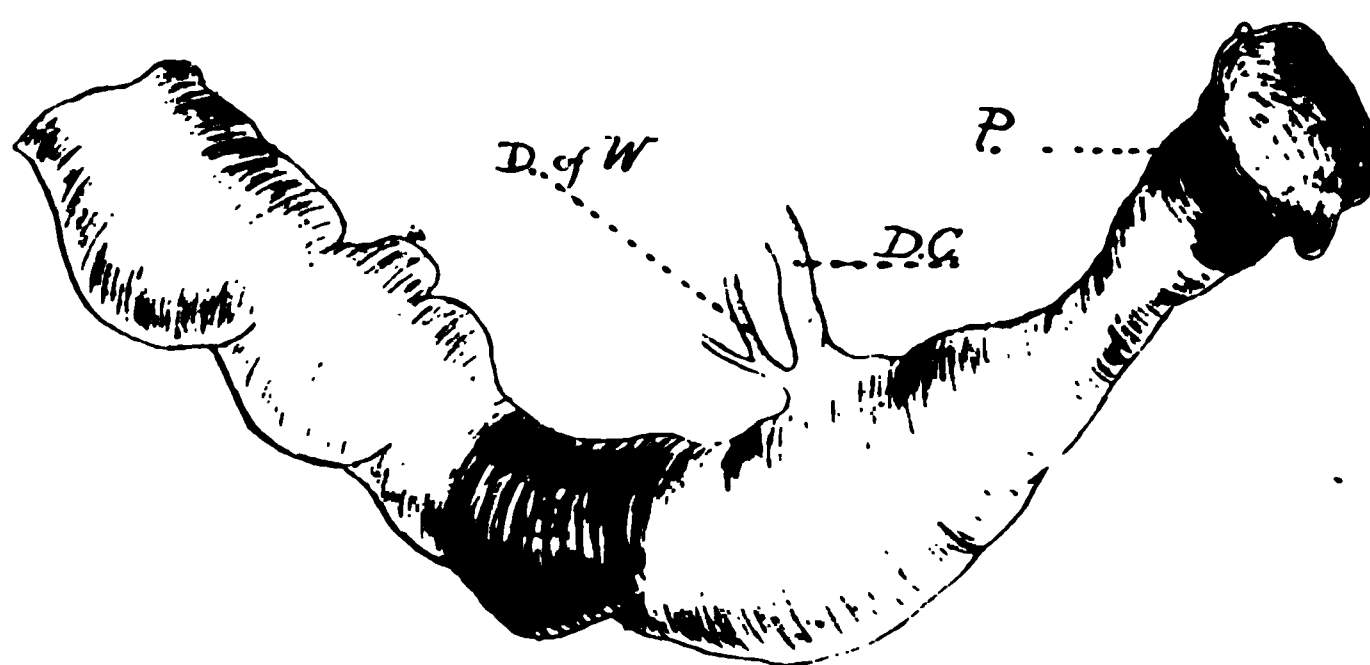
This seemed to indicate that there must be some point near the entrance of the common duct into the duodenum which regulates the passage of food through this intestine.

These clinical observations induced us to make a careful anatomical study of this portion of the small intestine, both in the living patient and in the cadaver.

An assistant, Dr. E. W. Thuerer, made a careful examination of the duodenum in thirty-nine cadavers, which revealed in every specimen an anatomical condition of the duodenum consisting in a marked thickening of the circular muscle fibres of this portion of the alimentary canal at a point be-



P., Pylorus; D.C., common duct; D.of W., duct of Wirsung, S, a double sphincter



P., Pylorus; D.C., common duct, D.of W., duct of Wirsung; S, point of greatest development of circular muscle fibre.

PLATE CVI.

Shows drawings of two specimens removed from the cadaver, showing the location of the circular muscle fibers of the duodenum.

low the entrance of the common duct. Plate CVI is a drawing of two typical specimens removed.

A considerable variation was found in the exact position of these muscle fibres. In some instances they were arranged in a narrow circular band forming a distinct sphincter; in others the thickening was diffused, making a broad, circular band; and in a few instances the thickening was in two different bands, with an intervening portion in which the circular muscle fibres were of the same thickness as the remaining portion of the duodenum.

There was a further difference in the location of this duodenal sphincter; in most specimens it was located from 3 to 10 cm. below the point of entrance of the common duct, while in a few instances a portion of the sphincter included a point of entrance of the common duct, the remaining portion, however, being always located below this point.

These conditions seem to explain a number of physiological facts; that vomiting when the stomach is relatively empty always expels a certain amount of bile; and that in many cases in which there is a dilatation of the stomach without constriction of the pylorus, with an ulcer in the pyloric end, the ulcer frequently extends into the duodenum. It may also explain some of the stomach symptoms which are so constantly observed in connection with gallstone disease. It will also explain a condition not infrequently encountered in operating for the relief of gallstones and ulcer of the stomach, that is, the presence of a greatly distended duodenum, with a completely contracted first portion of the jejunum.

It also explains the presence of the bile-staining of the portion of the duodenum above the common duct in the cadaver, while the portion below this point is usually free. This has been noted by many observers.

It has seemed as though this arrangement of circular muscle fibres served the purpose of a sphincter to facilitate the process of mixing the bile and the pancreatic juice in the duodenum; which has been so perfectly described by Cannon.

The presence of a gastric ulcer in a considerable proportion of patients that have suffered from chronic appendicitis may have some relation to this condition in the following manner: There is undoubtedly an obstruction of the ileocecal valve, due to the physiological contraction of this sphincter during an acute exacerbation of appendicitis, for the purpose of establishing a condition of rest in this vicinity. This is followed by nausea and vomiting, and it seems reasonable to suppose that the ileocecal valve initiates return peristalsis and that this in turn excites a contraction of the duodenal sphincter and the pyloric sphincter, and that in this way a normal passage of food from the stomach into the intestines is interfered with, causing an accumulation of residual food in the stomach, and that the irritation caused in this manner may be an etiological factor in the production of gastric ulcer. It may also explain the presence of bile in the vomitus of patients suffering from intestinal obstruction.

ABSCESS OF THE LIVER.

Cases of suppuration in the liver, other than those found in tropical countries, are usually due to metastases of pyemia.

Dysentery is far the most frequent cause of abscesses of the liver. They are very common in the tropical countries where the various inflammatory conditions of the bowels produce a thrombo-phlebitis of the mesen-

teric vein; the clots decompose, become dislodged and carry the infection through the branches of the portal vein, resulting in abscesses of the liver.

The amoebæ dysenteriae have frequently been found in the pus from these abscesses.

Liver abscesses, other than those occurring during the course of dysentery, may be due to gall stones, typhoid fever, intestinal ulcers, inflammation in region of the portal vein, trauma, syphilis and also as one of the complications following a suppurative appendicitis. It also has resulted from actinomycosis of the liver.

Symptoms.

The most constant symptoms are, first, a history in which dysentery and chill appear; second, general malaise pronounced; third, pain and tenderness over liver; fourth, enlargement of the liver; fifth, hectic sweats, and rigors; sixth, right-side posture; seventh, erratic temperature running from 96.5 to 103.5° F.; eighth, progressive emaciation; ninth, gastric disturbances.

Pain in region of liver is usually an early and prominent symptom. The pain often follows the course of the phrenic and fourth cervical nerves and radiates toward the right shoulder. It is usually constant from the onset. By carefully noting the exact limits of the pain and tenderness the abscess may often be located. Pain is always increased by digital pressure.

Enlargement of the liver is perhaps the most invariable objective symptom, and usually causes a bulging of the right hypochondrium. The enlargement may take place in any direction. The expansion takes the course of the least resistance and may be the means of determining the seat of the abscess.

Prognosis.

The prognosis is unfavorable especially in cases of multiple abscesses. The patient may succumb to the primary infectious disease, or to pyemia or sepsis, or the abscesses may rupture into the peritoneal cavity causing a septic peritonitis, or may rupture into the pleural cavity resulting in septic pneumonia.

Treatment.

The treatment is operative. The liver must be reached by crossing either the pleura or the peritoneum, the route chosen according to the location of the abscess. If there is reason to believe that the abscess is not pointing toward the pleura, or has not ruptured into it, the liver is reached through the peritoneal cavity by making an incision high up through the right rectus abdominus muscle. The abdominal cavity is carefully walled off by gauze pads. If the abscess is not readily discovered, the liver may be explored by means of an aspirating needle. The abscess is then incised freely and the cavity packed with iodoform gauze. Other pieces of iodoform gauze are so arranged as to protect the general peritoneal cavity and brought out through the incision.

In cases in which the abscess is evident on exposure of the liver, the operation may be done in two stages. The surface of the liver at the point of suppuration is exposed, and the wound packed with iodoform gauze and left three or four days until adhesions have formed, and then the operation is completed.

In passing through the pleura, it is necessary to resect one or more

ribs. When the parietal pleura is incised its edges are caught by hemostatic forceps. The diaphragmatic pleura is now incised and its margins sewed to those of the parietal pleura so as to close the pleural cavity. The operation is completed by incising through the diaphragm and draining the abscess freely.

In cases in which there is redness and edema of the skin, making it evident that adhesions exist, the abscesses may be incised directly.

HYDATIDS OF THE LIVER.

This disease is caused by a parasite known as the *tenia echinococcus* whose normal habitat is in the intestinal canal of dogs, jackals and wolves.

The disease is most prevalent in Australia and Iceland where the natives are not cleanly and live in close association with dogs.

The *tenia* are taken into the alimentary canal with the food, or more commonly with drinking water. According to Fowler their albuminous envelope is partly digested in the stomach and thus set free they burrow into the tissues and most frequently enter a radicle of the portal vein and are thus carried to the liver.

There is some question as to what becomes of the liver tissue where these large cysts develop in the organ. Some authors believe that an atrophy takes place, while others think that a hypertrophy occurs.

When the cyst is fully developed there is a sac filled with fluid in which float smaller cysts known as daughter cysts, and sometimes there are tertiary cysts inside of these.

The hooklets of the parasite are usually found in the cyst wall.

The cyst may exist for many years and only be discovered at autopsy. The great danger is that they may rupture. However, this is not necessarily fatal as they may rupture externally or into the intestinal canal. A cure may result in this manner. If the rupture occurs into the pleural cavity, gall bladder or peritoneal cavity, it is almost invariably fatal. If infection occurs, the disease may resemble a liver abscess.

Symptoms.

The symptoms vary according to the size and location of the cyst. When large and near the surface it may be felt as a globular tumor, rather elastic and sometimes fluctuating. If the tumor is behind the liver, there may be no symptoms at all. Most patients complain of a sense of distress and weight in the hepatic region. As the tumor grows there may be pressure symptoms, as dyspnea and cough from extension upwards to the diaphragm. Pressure on the portal vein may result in ascites, jaundice or hemorrhoids. The hydatid fremitus is seldom present. It is only present when the daughter cysts swim in the fluid.

Diagnosis.

The diagnosis is often difficult as many of these patients may remain in good health for years. It may be differentiated from cancer and abscess by the long history, slow growth, the absence of loss of weight and the lack of the pronounced constitutional symptom present in abscess. Its shape and absence of biliary symptoms rule out gall bladder disease. The fact that the colon does not overlie the tumor, rules out cystic or sarcomatous kidney.

Treatment.

The treatment consists of evacuation of the cyst contents and removal of the lining of the cyst cavity and drainage of its cavity, or, in a few selected cases where the cyst is pedunculated, excision of the entire cyst.

The operation of drainage of the cyst may be done in two stages, after the method of Volkmann, which consists of opening the peritoneal cavity and placing sterile gauze pads between the cyst wall and the peritoneum to cause adhesions to form between the liver and the peritoneum, or suturing the cyst wall to the peritoneum, and three or four days later opening and draining the cyst.

The operation most commonly done consists of making an incision over the most prominent part of the swelling, then carefully packing away the stomach and intestines with sterile gauze pads; a trocar is inserted into the cyst and as much fluid as possible is withdrawn. The cyst is then incised and the remainder of its contents sponged out. The lining of the cyst, which is known as the parasite endocyst, is removed. The edges of the cyst are sutured to the peritoneum and the cyst cavity packed with gauze.

The after-treatment consists in gradually diminishing the amount of packing at each dressing until the cyst cavity is obliterated.

INJURIES OF THE LIVER.

The liver is apt to be injured by crushing accidents, as when a heavy wagon wheel passes over the body; also by blows or falls which break one or more ribs, which puncture the liver, or from penetrating wounds.

The symptoms of rupture of the liver are those of internal hemorrhage and severe shock, such as extreme palor and cold skin, feeble and rapid pulse, sighing respiration; the abdomen becomes swollen and tympanitic and sometimes dullness from the collection of blood. Often there is vomiting, thirst and syncope.

Treatment.

The treatment should be directed toward the control of hemorrhage as soon as possible and to prevent the retention of bile in the peritoneal cavity on account of its liability to cause cholemia.

WOUNDS OF LIVER.

If from the site of injury it is thought that the injury to the liver is in the left lobe, or is undetermined, it is well to make a median incision.

In wounds of the right lobe a longitudinal incision is made through the outer edge of the right rectus abdominus muscle and then, if found necessary, this may be converted into the "S" shaped incision, as suggested by Bevan, or into the Robson incision.

Wounds of the liver may be treated by suture or cautery or by gauze tampon, or by suturing a piece of sterile gauze down upon the bleeding surface.

In the majority of cases a little pressure by means of a gauze pad for a few minutes will control the hemorrhage. In some cases it may be necessary to make continuous pressure over the bleeding surface. This may be done by suturing a piece of iodoform gauze over the bleeding surface by a

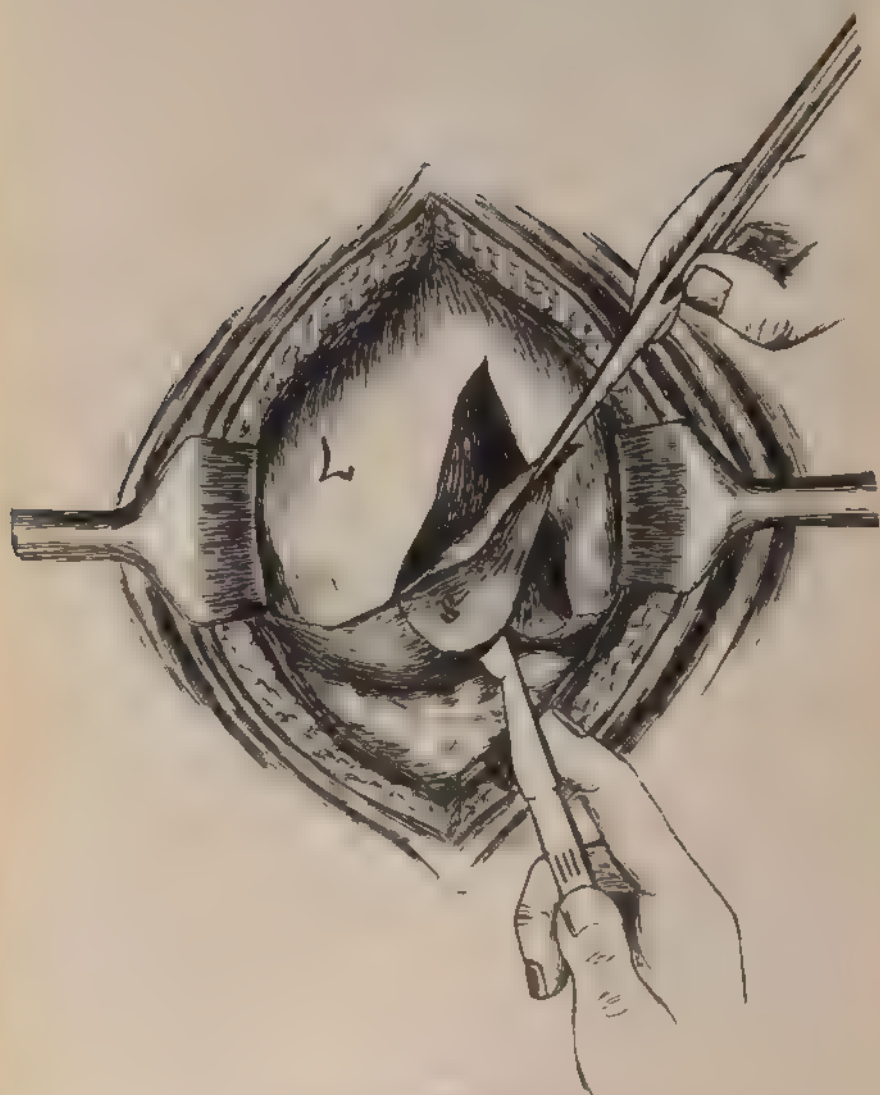


PLATE CVII
L. Liver S. Section removed (Frank.)



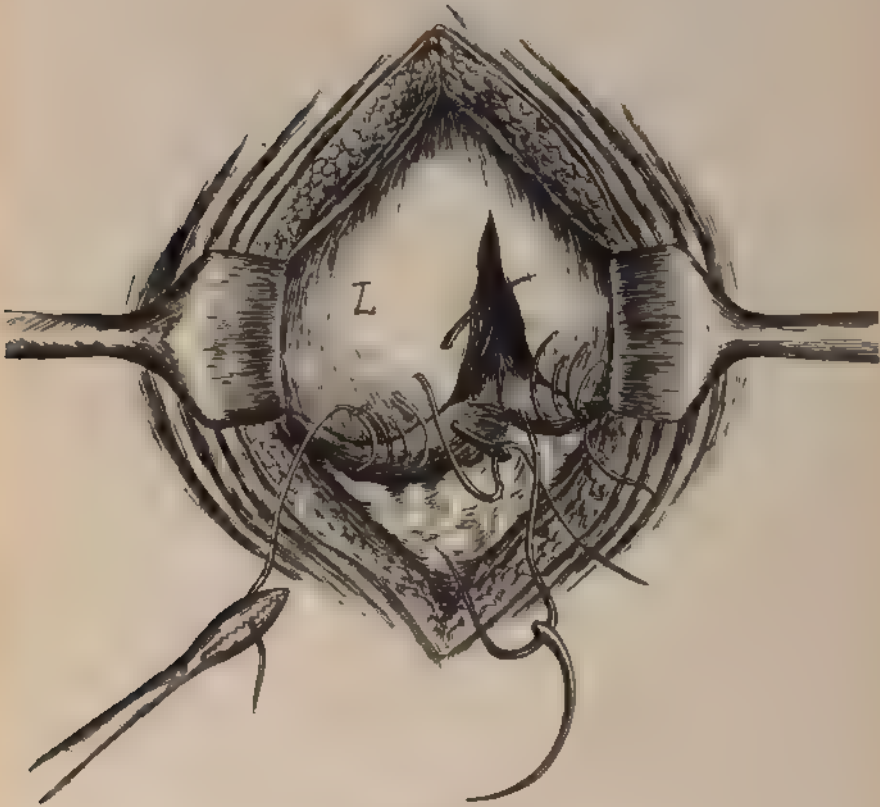


PLATE CVIII

L. Liver with wound partially sutured (Frank)

few catgut stitches and bringing one end up through the abdominal wall. The gauze will make continuous pressure and the stitches will prevent the displacement of the gauze should the patient cough or vomit. The catgut will be absorbed in a few days so that the gauze may then be readily removed. Bleeding may also be controlled by suturing the liver, using a non-cutting needle threaded with catgut. The sutures are passed directly through the liver substance, then tied just tight enough to bring the edges of the liver together, the blood pressure in the liver is very low and is controlled by slight pressure.

In large wounds with considerable destruction of liver tissue it is better to use the method of suture as devised by Frank. This consists in the excision of a portion of the liver, as shown in Plate CVII, removing a wedge-shaped piece, leaving the organ with two flaps forming a trough. If there is much bleeding from the cutting of the liver tissue, it is controlled by ligating the bleeding vessel, or by passing a mattress catgut suture through the entire thickness of the liver surrounding the vessel. The flaps are now coaptated. For this purpose a long non-cutting needle is threaded with catgut and a running stitch is commenced at one end and continued, as follows (Plate CVIII): One suture is carried through the liver tissue near the bottom of the trough and then one superficially, and so on alternating. The stitches should not be tight, but drawn just enough to bring the two tied flaps together in perfect coaptation, obliterating all dead space. The continuity of the liver surface is re-established and no raw surface or ragged edge is left.



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PART VIII.

SURGERY OF THE GENITO-URINARY TRACT.

In considering the surgery of the kidney especial stress should be laid upon diagnosis, because this is really the most difficult task connected with the subject. The examination of urine is most important, but it does not in itself result in a definite surgical diagnosis.' The presence of albumen, tube casts and characteristic epithelial cells from the kidney indicate nephritis in one or both kidneys, but it does not make a surgical diagnosis. The presence of blood or pus indicates a bleeding or suppurating point in the kidney, the ureter, the bladder or the urethra, but again it does not definitely locate the diseased region; consequently these findings can act only as corroborative evidence and serve but to confirm a diagnosis made without their aid. Were it possible to obtain the urine from each kidney separately this difficulty would in a measure be overcome, because it would locate the source of these substances and determine the diseased organ. At the same time it would be possible to learn whether the other kidney was sufficiently active to be depended upon to perform the entire work. In the female this can be done with comparative ease through a large speculum, the patient being placed in the knee-chest position and the bladder permitted to inflate itself with air, which it does spontaneously whenever a speculum is inserted with the patient in the position named. In the male, it may be accomplished by the aid of a cystoscope.

It is, however, to be remembered that the opening of the ureter into the bladder is a delicate mechanism which frequently prevents infectious material existing in the bladder from infecting the ureter and the kidney for a long period of time, and also that in cases in which one suspects a diseased kidney the bladder is very frequently not aseptic and one consequently runs the risk of infecting the other kidney also by carrying septic material from the bladder into the ureter. Moreover, it is likely that after the ostium of the ureter has once been distended for the introduction of a ureteral catheter it may no longer be so certain to guard against infection of the ureter and kidney from the bladder. A number of surgeons have observed infections of the kidney from the practice of ureteral catheterization. It therefore seems at the present time to be an unwarranted procedure, except in the hands of surgeons especially trained in the use of the cystoscope and the ureteral catheter; and then only when needed to make a diagnosis in cases in which a positive determination is of importance and cannot be made without recourse to this method. However, quite the same result may be obtained without disturbing the ureter by producing a peculiar watershed in the bladder, causing the urine from each ureter to flow into a separate receptacle. This

is accomplished by means of the Harris' segregator, which is illustrated in Fig. 24. The use of the instrument is described by Harris as follows:

HARRIS SEGREGATOR.

"The instrument is used in the following manner: The patient, male or female, is placed comfortably on a table in the ordinary lithotomy position, with the hips slightly elevated. The instrument, with the flattened surfaces in contact so as to form practically a single catheter, is introduced into the bladder in the ordinary way. As soon as the proximal, curved extremity is within the bladder, the proper distance being indicated by the gradual scale, each catheter is rotated about its longitudinal axis until each proximal end, as indicated by the distal end, is directed outward and backward. The end of each catheter should pass through an arc of about 110 to 120 degrees, or so that the angle subtended posteriorly by the two catheters will be about 120 or 140 degrees. They are held in this position by a small spiral spring. The ends of the proximal extremity will now be in the neighborhood of, but not exactly at, the ureteral openings. The ends are separated a greater distance than the distance between the ureteral openings, so as to avoid the danger of compressing the opening of the ureter, and thus preventing the escape of the urine. The lever is now introduced into the vagina in the female or rectum in the male. By gentle pressure forward directly in the mid-line, the base of the bladder is raised into a longitudinal fold between the ureteral openings.

The curve of the lever is such that it fits nicely in the angle formed by the separating extremities of the catheters, thus forming a complete watershed. The end of each catheter now lies at the most dependent part of a little pocket—a perfect watershed separating the two. The ureters open, one on either side of the watershed near the base of the declivity in the immediate vicinity of the respective ends of the catheter.

By producing a gentle exhaustion of the air in the vials by means of the bulb, the urine, as fast as it escapes from the ureters, drops directly into the ends of the catheters and flows at once into the vials, right and left, respectively.

The instrument and its application are so simple that its advantages are apparent at once, and hence need no arguments to support them.

This being the case, we may proceed at once to dispose of any possible objections that may suggest themselves.

The possibility of compressing the opening of the ureter and thus preventing the escape of the urine from that source is noted as already mentioned.

In diseased conditions of the vesical mucosa, it is more than an examination may, upon first thought appear to be, a source of contamination of the urine with pus and blood. Upon reflection, however, this will be recognized as a possibility, but not a necessity, should be thoroughly cleansed by means of the irrigator, using the instrument. After the instrument is in place, the bladder may be again cleansed by irrigating the catheters through the side tubes on the distal end of the instrument, protruding into the bladder.

The urine is retained in the bladder until the lever is raised at once into the catheters, so that it passes into the vials, and the mucosa. The end of the catheters is near the opening of the ureters, and the urine

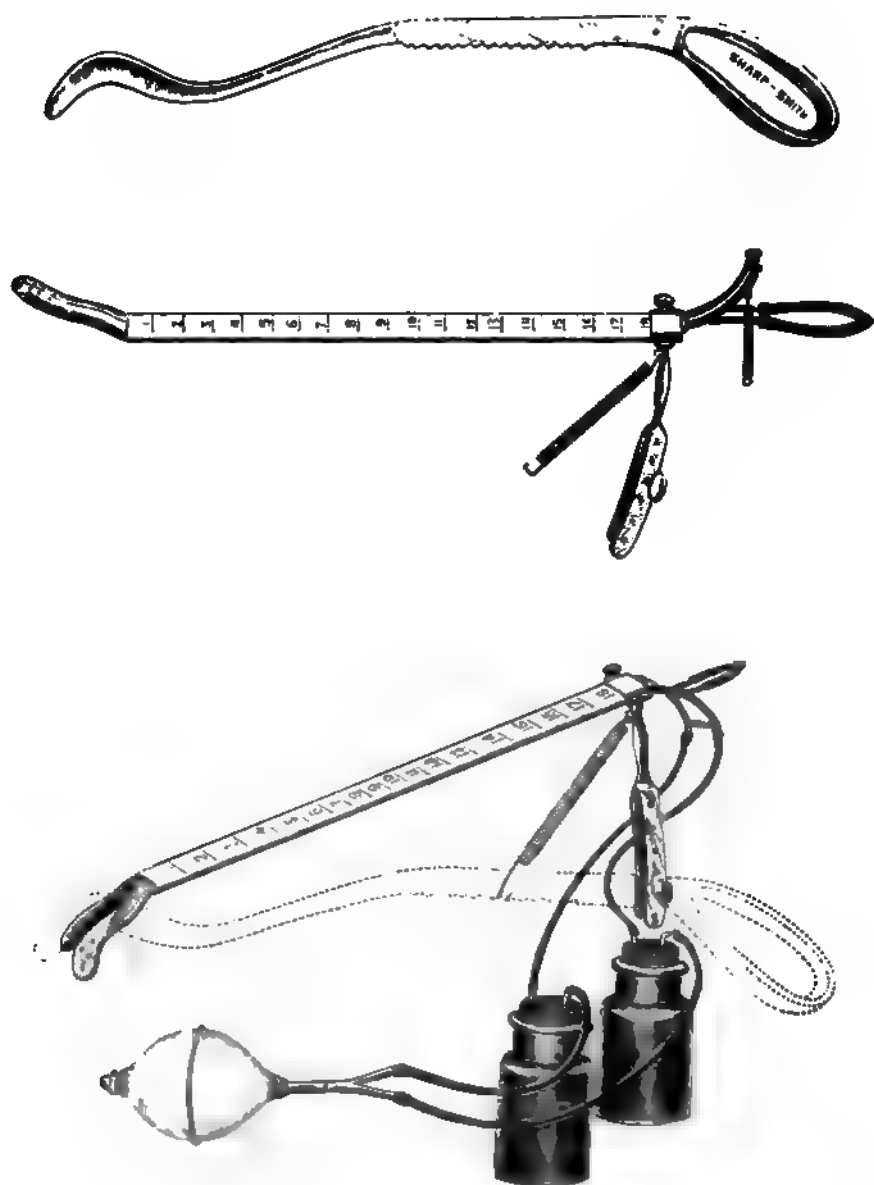


Fig. 24.
HARRIS' SEGREGATOR.



ACCEPTED MANUSCRIPT



comes in contact with an extremely small portion of the bladder surface. The examination is not continued long enough at any time for pus (for instance) to be formed in sufficient quantity to be taken up by the catheter. Hence, it will be seen that contamination, even when the bladder is diseased, will be slight.

It is likely that in certain greatly enlarged prostates or growths of the so-called middle lobe, or in vesical calculi or chronically inflamed and contracted bladders, the instrument would not be applicable, but such cases form a very small minority of those in which its use would be desirable.

The little straight tubes, when not being used for irrigation, must, of course, be closed air tight by simply tying the little rubber tubes attached to them, or passing the opposite ends of a single tube over each straight end. Aspiration with the bulb should not be too great so as to draw the mucosa into openings of the catheter. Very slight aspiration is all that is necessary. As a few drops of fluid are apt to remain in the bladder even after the use of the catheter, the first few drops that come over should be discarded.

The instrument should be opened carefully when in the bladder, so as not to excite hemorrhage by injuring the mucosa. The proximal curve should be just within the bladder, which is determined by noting the length of the urethra on the scale. Introduce the instrument into the bladder and open it before introducing the lever into the vagina or rectum. The ends of the catheters are easily felt through the vagina or rectum, and the lever should be directly in the middle, midway between the two ends, and pressed snugly into the angle. Sufficient pressure should not be used to cause pain, as the watershed is very easily formed. The urine does not drop continually into the vials, but intermittingly, just as it escapes from the ureters. The use of the instrument is not painful and does not require an anesthetic, except possibly in an over-sensitive or nervous patient, who would not submit to any manipulation whatsoever.

By attention to these simple rules the application of the instrument will be found very simple, and the results all that could be desired."

The instrument is contraindicated only in cases in which its introduction is likely to cause severe traumatism on account of the inflamed condition of the urethra or the bladder. These cases can be easily eliminated and form but a very small proportion of all those in which one might desire to make a separate examination of the urine from the two kidneys.

Many other instruments intended to accomplish the same end have since been invented but none of them seem to be as reliable as the Harris. Moreover, the number of men who can safely catheterize the ureter has increased to such an extent since the time when this instrument was invented that the necessity for using such an apparatus is no longer so marked.

INFECTION OF THE KIDNEY.

Typical History.

The patient, a married woman thirty years of age, gives the following history: In good health as a child. Began to menstruate at fourteen; regular; painless. Married at twenty-two. Two pregnancies; labors normal. Second child four years ago. Has never felt well since. She had difficulty in emptying the bladder after the child-birth. On the eighth

day after confinement she was taken with severe pain in right side of the abdomen, which lasted for about three months. Since then has had numerous attacks of pain in the same region, with intervals varying from one week to two months. Attacks vary in severity. Has often been confined to bed, and the attacks have been accompanied by fever and vomiting. The attack lasts from a few hours to three days. The patient is often jaundiced during these attacks. About four weeks ago this patient was taken with pain in the right side, accompanied by a severe bearing-down sensation. At this time she noticed a mass in the right side of abdomen the size of an orange. Has had no vomiting and does not think she has had much temperature with this attack. The pain has been almost constant up to the present time, but the tumor has decreased somewhat in size.

Present Condition.

Greatly emaciated, appetite good, heart and lungs normal. Abdomen scaphoid. A fluctuating mass, somewhat tense, extends from the right costal arch to a little below the umbilicus inward to the median line. It is plainly palpable on bimanual examination with one hand in the lumbar region and one on the abdomen. It is quite tender and seems to move slightly on deep inspiration. The perineum is slightly lacerated; cervix also slightly torn. The cervix is long and hard. The uterus far down in pelvis, normal position, fornices empty, adnexa apparently not connected with mass above.

During the paroxysms or periods of illness there is always an increase in the size of the swelling and a decrease in the flow of urine, but the latter is less turbid at such times. As the flow increases and becomes more turbid the patient's condition improves and the swelling decreases in size.

The heart and lungs are normal. The urine contains a considerable amount of pus, but is otherwise normal. Upon examining the urine from the two kidneys separately, by means of the Harris segregator, it is found that the fluid secured from the left ureter is normal, while that from the right kidney contains pus. The microscopic examination of the urine has failed to demonstrate the presence of tubercle bacilli.

Diagnosis.

The swelling is located in the vicinity of the right kidney and the ascending colon. Frequently an appendix is located as high up and sometimes a gall bladder is located as low down. The presence of jaundice and the persistent gastric disturbances might indicate an empyema of the gall bladder, or gall stones. The same conditions frequently occur in the case of a chronic retro-cecal appendicitis. A tuberculosis of the ascending colon with adhesions between the omentum and transverse colon might cause the same symptoms. The two elements, however, which seem to establish the diagnosis are: 1. The fact that there is pus in the urine coming from the right kidney, and, 2. The fact that the condition is evidently the result of a puerperal infection which first affected the bladder and then the ureter, and, by way of an ascending infection, the kidney. This is still further confirmed by the regular variations in the size of the swelling and by the synchronous changes in the character of the urine. The patient lived in a small town in the mining regions at the time of her confinement, where she could not obtain medical care and good nursing; hence it is likely that there remained residual urine in the bladder for a



PLATE CIX

Atrophy of kidney structure with the formation of a large cyst Dilatation of the ureter from obstruction

considerable time and that the pelvis of the kidney was greatly dilated by the return pressure. The infection of the pelvis of the kidney probably occurred on the eighth day after confinement, when the patient suffered the severe pain.

So long as there was fairly good drainage from the distended pelvis of the kidney through the ureter, there were no serious symptoms, because there was but a slight amount of absorption, the pus being diluted with urine constantly secreted. But as soon as the ureter became temporarily blocked by an accumulation of thick pus, or on account of edema, the confined urine became more septic and absorption more extensive. The increased pressure increases the pain, and the absorption increases the temperature. The gastric disturbance can be accounted for by the same conditions. Jaundice frequently accompanies abscesses of the kidney or the appendix, without direct involvement of the liver or the biliary tract, although these parts are frequently involved secondarily. The most important point in determining the differential diagnosis, however, is the demonstration of pus in the urine from the right kidney, and normal urine from the left. We can consequently make a positive diagnosis of pus in the pelvis of the right kidney without being able to positively exclude the presence of disease in the vermiform appendix, the gall bladder and biliary ducts.

The disease has existed for four years and the history of the case shows that the infection has probably extended upward through the ureter from the bladder. It is difficult to determine in any given case what secondary conditions may have resulted in this period of time. The fact that aside from the presence of pus the urine is nearly normal would indicate that no great amount of destruction of kidney tissue had occurred, but that the disease is chiefly confined to the pelvis of the kidney.

Obstruction to the flow of pus and urine from the right kidney during periods of exacerbation of the disease might indicate an obstruction of the ureter due to the presence of a renal calculus, which could readily have formed with the conditions present in this case, or an occlusion due to the presence of thickened pus or to an edema, or to an acute bend in the ureter, or through the presence of an abnormally placed blood vessel compressing the ureter. In case the obstruction is due to a calculus the relief which occurs when the calculus is displaced is usually much more sudden and more complete than it was in this case. Obstruction from an acute bend of the ureter occurs only in cases in which the kidney is abnormally movable, which is not evident in this patient. However, so far as the treatment and the prognosis are concerned, it is immaterial to the patient whether this part of the diagnosis be made before or during the operation.

Indications for Operation.

It is plain that unless this patient obtains relief from her present condition she will continue in her downward course, which has become more and more marked as time has progressed during the past four years. The constant absorption of pus will not only continue to jeopardize her nutrition by interfering with her appetite and her digestion indirectly, but it will undoubtedly result in amyloid degeneration, especially of the kidneys and the liver. The constant presence of pus in the bladder is likely to result in an infection of the pelvis of the left kidney, which has as yet escaped. Sooner or later, the tissues of the kidney itself will become in-

flamed, and then only the left kidney will remain to perform the labor of both organs. Aside from this there is always the danger of metastatic infection of other parts of the body from the presence of this accumulation of pus, either by extension or by metastasis, because this is possible in case of an accumulation of pus in any part of the body if the drainage is not perfect. The only way in which relief can be obtained is by direct drainage by means of a free incision.

Preparation for Operation.

In order to insure against an accident occurring rather frequently after operations upon the kidney—which consists in a complete absence in the secretion of urine by both kidneys and consequent uremia—it is wise to provide for very free elimination before the operation is performed, first, by the administration of cathartics, and, second, by having the patient drink great quantities of distilled water, preferably hot. In the meantime the patient is placed for a week upon a simple milk diet.

In order to increase the activity of the glands of the skin, she will receive warm baths daily. On the day before the operation two ounces of castor oil will be given as usual. In this way it is possible to place the patient's kidneys in a fairly safe condition even where there has been much impairment of their function.

Technique

The operation must primarily be exploratory, because the condition of the kidney must determine the course to be employed. If the condition of the kidney is such as to preclude the possibility of its restoration to normal, as a result of a conservative operation, then its removal is indicated, because the examination with the Harris segregator has demonstrated the fact that the left kidney is normal. On the other hand, if it is possible to preserve the kidney this must by all means be done. Were the other kidney not normal, it would not be wise to remove the diseased one, so long as any portion of it remains capable of excreting urine, even though it might not be possible to obtain a perfectly normal kidney as a result of the operation, because a patient can live longer with two impaired kidneys than with one.

Were this patient suffering from a tuberculosis of this kidney our position would be quite the reverse, because then we would remove this kidney even though it might not be seriously diseased, as if a tuberculous kidney is simply drained the other kidney is almost certain to become involved, while if it is removed the physiologic increase in the circulation of the second kidney seems to overcome a slight amount of tuberculosis after the first kidney has been removed.

Beginning at a point near the twelfth rib, an incision is carried downward toward the crest of the ilium through the edge of the erector spine and quadratus lumborum muscles. Long care must be taken to distinguish the iliohypogastric nerve and to protect it downward in order not to injure it. It is well to take care to make the incision extend sufficiently well for palpation and inspection. The extent of the incision is that of the kidney. Were we to attempt to remove the diseased kidney, the incision would be extended to the level of the iliac crest, and the extent of the incision would be determined by the size of the diseased kidney. The incision is made in front of the kidney, and the diseased kidney is removed.

The apertures in the muscle are closed by this incision, unless it

is too extensively adherent, and it is also possible to remove gall stones from the gall bladder through the same incision, although the incision which has been described before is much to be preferred.

In this case, however, opening of the peritoneum would not be proper, as it would increase the likelihood of an infection of the peritoneal cavity.

The fat capsule is opened and a dark, oblong organ is seen in the wound. Grasping this between the fingers it is found to fluctuate. This is undoubtedly due to the presence of pus in the dilated pelvic cavity. An incision two inches in length is made through the cortex of the kidney a little behind the center of its convex surface, which is supposed to be the least vascular portion of the organ. Immediately there is a free flow of pus diluted with urine. The finger is inserted into the pelvis of the kidney and this cavity is carefully palpated, each calix being explored with the finger, in order to determine the presence of a renal calculus. The entire pelvis is lined with granulation tissue and there is a considerable amount of thickening of the tissues of the pelvis. The cortex of the kidney is thin and somewhat congested, but otherwise normal. A large probe with a bulbous end is introduced into the ureter and this is found free from obstruction by a stone.

A catheter is now introduced into the bladder through the urethra and held closed, then a small catheter is introduced into the ureter through the kidney. The urine is permitted to flow from the catheter in the bladder and simultaneously a one-half per cent solution of methyl blue is injected into the other catheter. At once the urine takes a blue color, showing that at the present time the ureter is open.

It seems likely that drainage of the kidney would result in restoration to a fairly normal condition, and that the kidney will ultimately become nearly as useful as its fellow.

In order to stimulate the healing of the pelvic cavity, and at the same time establish free drainage, the pelvis will be tamponed carefully with iodoform gauze. A rubber drainage tube will also be inserted into this cavity, the gauze being tamponed around this. The drainage tube and gauze are carried out through the wound and the latter is sutured above and below it. A large dressing applied to the surface completes the operation.

In case a kidney has been split longitudinally, as in this case, and the pelvis has been found to be in an aseptic condition, which is not infrequently true in cases in which a uric acid or an oxalate of calcium calculus is found, it may be unnecessary to tampon the pelvis of the kidney with gauze. In these cases it is well to insert a Jacob's retention catheter into the lower end of the wound and to suture the remaining portion of the wound with catgut suture passed through layers of iodoform gauze placed upon the flat surface of the kidney on either side to prevent the sutures from cutting.

After-Treatment.

Occasionally a hemorrhage occurs upon removing the tampon which has been placed in the kidney, because the blood vessels in this organ are characterized by especially thin walls, making their closure very unstable. On this account it is wise to postpone withdrawing the tampon until it has been loosened by the development of granulations. It may be removed a little at a time until it has all been loosened. In the meantime the urine

drains through the wound and the mucous membrane lining the ureter has an opportunity to become normal, because the flow of pus and urine through this canal no longer causes an irritation.

In cases like the one instanced the urine usually becomes clear in a few days, as the drainage through the wound is so free that there is no accumulation. The pelvis of the kidney, which has been dilated for a long period of time, becomes contracted for the same reason, and all of the conditions become more nearly normal in a comparatively short period. It is wise to continue the drainage until there is no doubt but that the pelvis of the kidney and the ureter are nearly normal, so that natural drainage will be established.

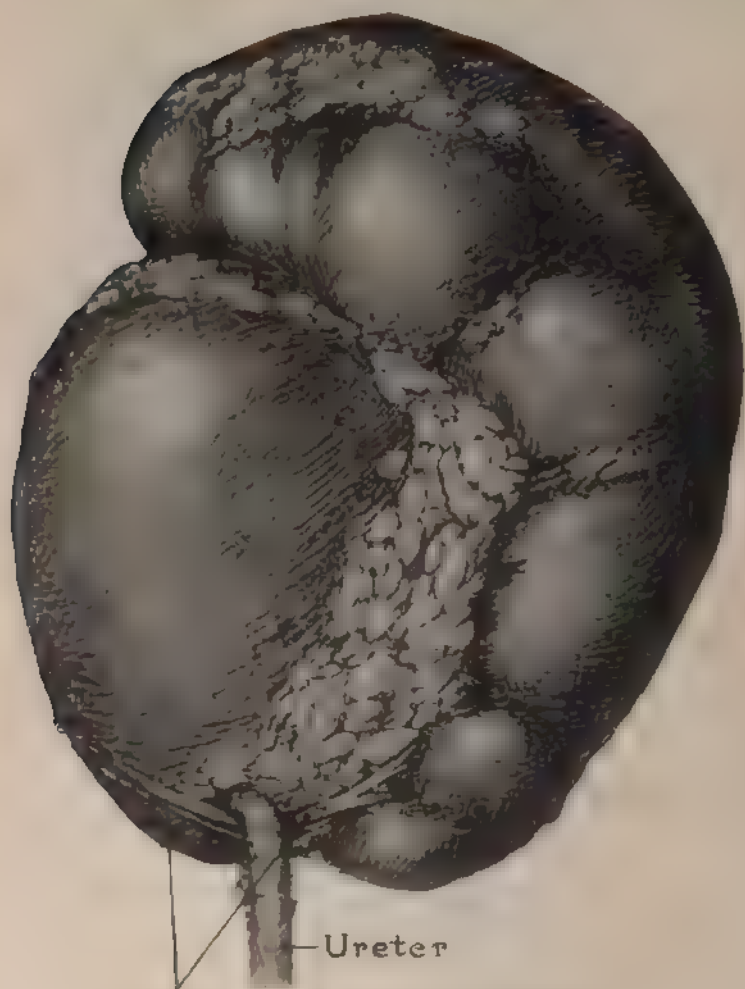
Use of Distilled Water.

The patient should receive an abundance of distilled water at intervals of one to two hours regularly, in order to dilute the urine, which will form a non-irritating fluid as it passes over the diseased surfaces. In pyelitis, and in fact in other conditions, such as renal calculi, in which the pelvis of the kidney is diseased, distilled water given internally in considerable quantities is a most useful remedy. Many patients who have suffered for years from renal colic are permanently and perfectly relieved by this simple means. It seems necessary for the urine to possess a certain concentration in order to make the formation of renal or cystic calculi possible in the absence of foreign bodies, which may account for the clinical fact that has just been described. The free use of distilled water results in diluting the urine to such an extent that renal calculi or renal sand no longer form. Moreover, the urine becomes exceedingly bland and non-irritating, and we have frequently observed not only a relative decrease of the pus in the urine from dilution, but also an absolute decrease, as a result of drinking distilled water freely.

It is well in these cases to administer five drops of dilute aromatic sulphuric acid in half a pint of distilled water every two hours, especially if there is a tendency to the precipitation of phosphates. This will cause the urine to remain sufficiently acid in reaction to keep the phosphorus in solution.

The Formation of a Fistula.

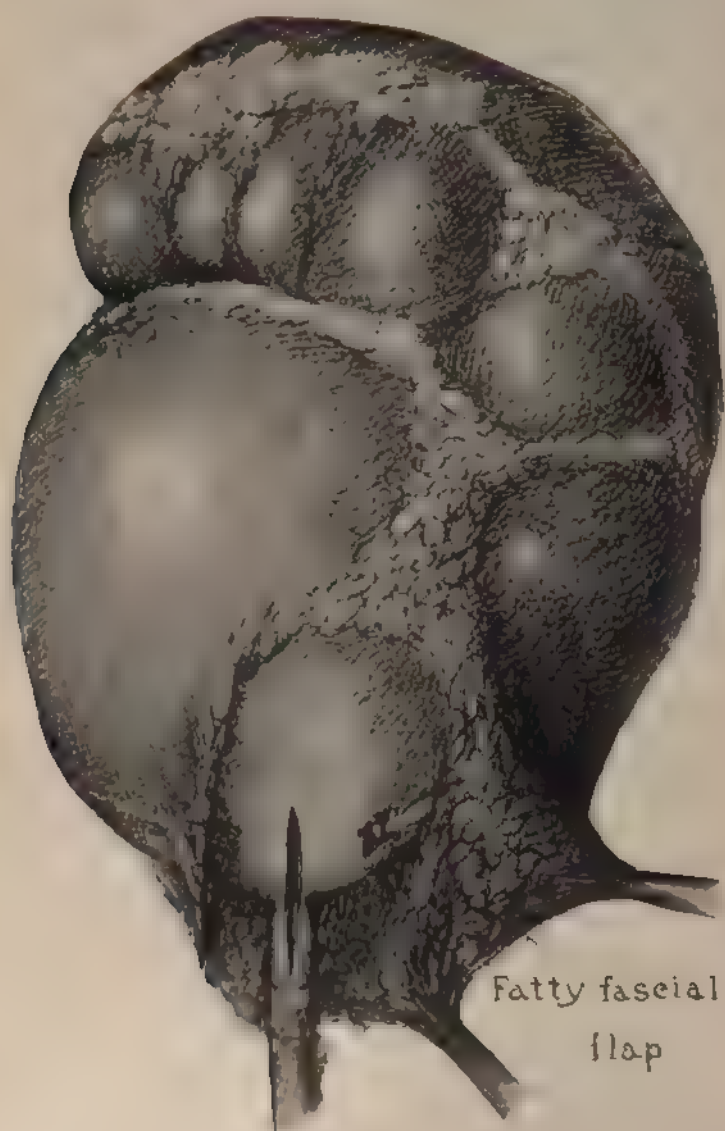
In case the ureter does not become normal in a relatively short time, which may occur, especially where the disease has existed for a long time, the wound in the kidney will not heal, and a fistula may persist, which is not only disagreeable because the dressings are constantly wet, but which results in an excoriation of the skin on account of the irritating effect of the urine with which it is constantly in contact. In these cases, it is advisable to introduce a soft rubber retention catheter with a bulbous end, preferably,—described elsewhere in this volume as a Jacobs catheter,—into the kidney and to weight the free end by inserting a glass tube into it and then placing this in a bottle, which may be carried underneath the clothing, suspended from a belt. At night a longer rubber tube is attached to the catheter and its free end is passed out into a vessel outside the bed on the floor. This tube will act as a siphon and the patient will remain entirely dry. Occasionally the ureter does not recover, and then it will become necessary either to remove the kidney or to be satisfied with the drainage which has been established, together with all of the resulting inconveniences.



Anomalous Blood-vessels.

PLATE CX.

Hydronephrosis from kinking ureter caused by anomalous blood vessels
(Mayo)



Fatty fascial
flap

PLATE CXI

Blood vessels cut and tied Fatty fascial flap raised and uretero-pelvic jun-
ture divided (Mayo)

The quantity and quality of urine secreted by the diseased kidney can now be easily determined, and it will be apparent from this whether the kidney should be saved. So long as the opening into the kidney is too large for the use of a retention catheter, the quantity of urine can be determined by weighing the dressings before they are applied and after they have been in place for a given time.

It is, however, not safe to judge of the condition of the remaining kidney by the amount of urine secreted into the bladder from it, while all of the urine is siphoned out through the catheter in the diseased kidney. In one instance of this kind in which we removed the diseased kidney notwithstanding the fact that but 180 cc. of urine was secreted from the other kidney the latter at once became more active, secreting 400 cc. on the third day after the removal, then advancing slowly until 2,000 cc. were secreted daily within three weeks, then very gradually reducing to 1,500 cc. when the normal amount of liquid nourishment and water was taken. The case was one in which the uterus had been removed for carcinoma in a very weak, emaciated patient. The lower end of the right ureter being involved it was excised with the cautery, for several days both kidneys secreted a normal amount of urine, one secreting into the vagina, the other into the bladder. Then the one secreting into the bladder produced less and less, running as low as 100 cc. on some days. The patient's condition became worse constantly. At the end of six weeks she seemed in a hopeless state, when she developed a pyelitis and we were forced to choose between certainly losing her from the pyelitis with uremia and losing her most likely from shock and uremia after a nephrectomy.

The fact that the left kidney had secreted normal urine directly after the hysterectomy determined us to make a very rapid nephrectomy, with the result stated above. It is consequently not proper to judge entirely by the quantity the other kidney secretes under these conditions as regards its ability after the removal of the diseased kidney.

We have also been able to confirm the observation of others in cases of tuberculosis of the kidney, that the removal of one kidney would result in the secretion of more urine, and urine of a better quality, by the other kidney than was secreted by both before the nephrectomy was made.

In case of intermittent hydronephrosis, whether the urine be clear or mixed with pus, it is always important when the kidney is first exposed to determine the character of the obstruction. If this is due entirely to a kinking of the ureter from a dropping down of the kidney and the ureter is not equally mobile with the kidney, simply dividing the adhesions holding the ureter and fastening the kidney in place by nephorrhaphy, as described elsewhere, will suffice. If the ureter is bent acutely over an aberrant blood vessel the latter should be caught between two pair of forceps, cut and ligated, and nephorrhaphy should again be performed. If the obstruction is due to a deformity of the pelvis itself then a plastic operation should be attempted, as originally recommended by Fenger. The method developed by Mayo, as illustrated in Plates CX to CXIII, is so satisfactory that we give it in full.

NEPHRECTOMY.

When we find the kidney hopelessly destroyed by infection, or a malignant growth of the organ, a nephrectomy can be done through the same

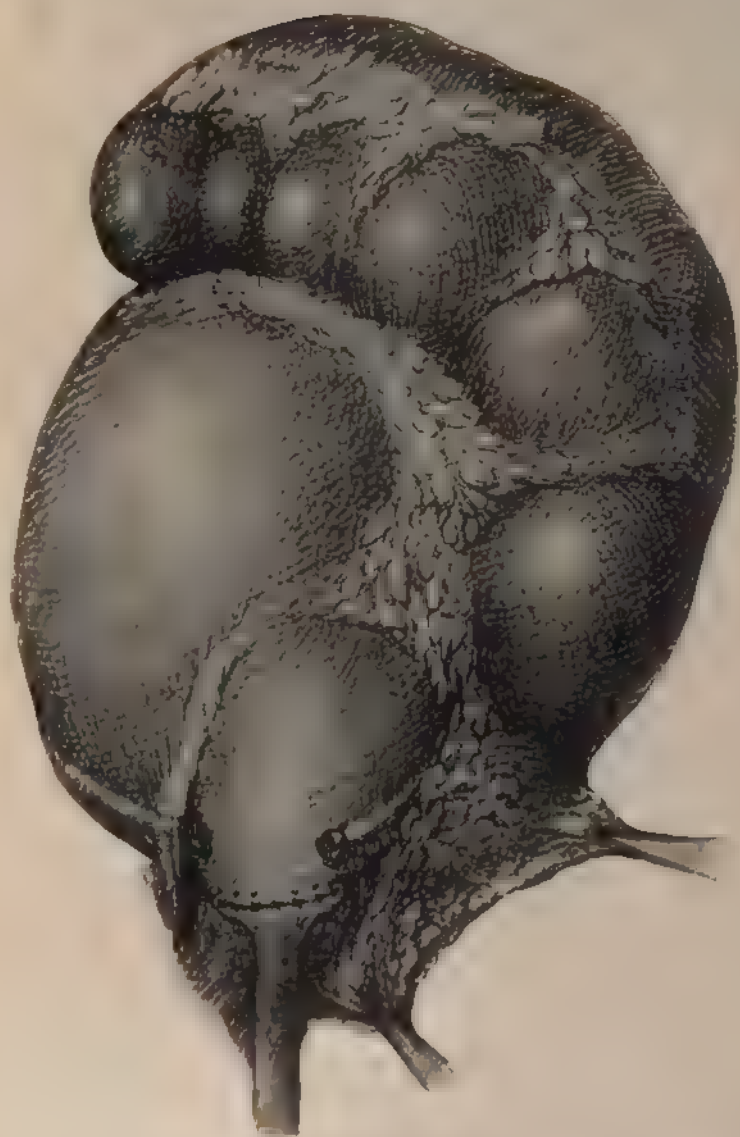


PLATE CXII

Fig. 1. Plastic operation on uretero-pelvic junction completed (Mayo)

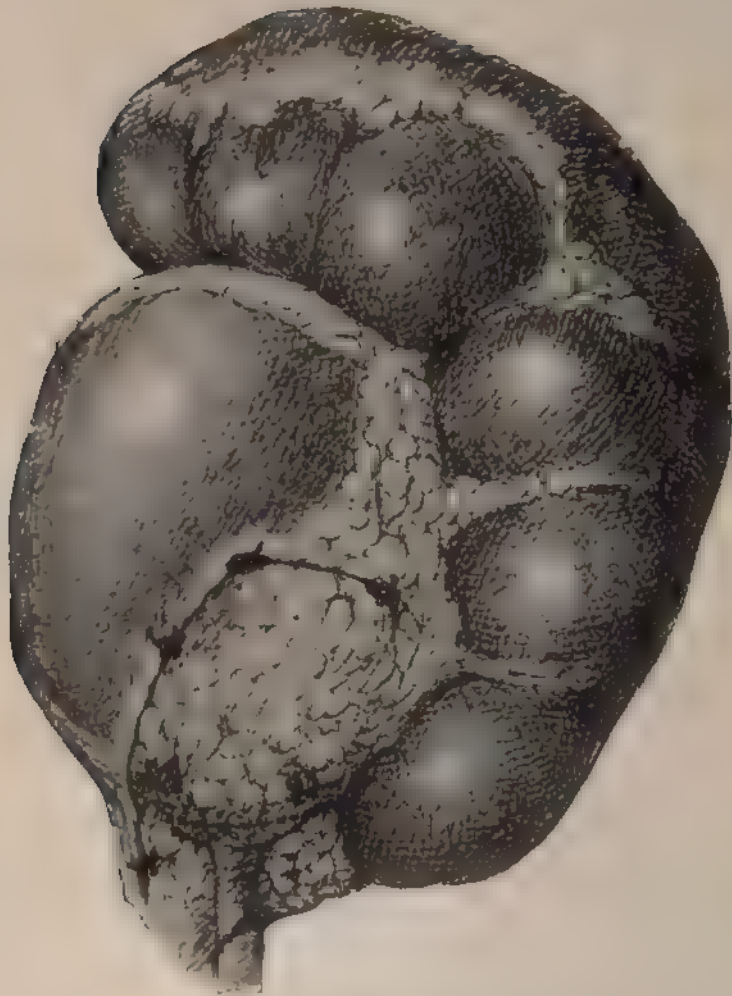


PLATE CXIII

Fatty facial flap in position and held by a few catgut sutures. (Mayo.)

mon if elimination has been favored before the operation by the use of milk diet, cathartics and an abundance of distilled water as where this precaution has not been taken.

Relative Anuria After Operation.

Should anuria occur subcutaneous transfusions of a quart of normal salt solution once or twice a day, and the use of saline cathartics and steam baths, and continuous rectal instillation of water by the drop method, are indicated. Some of these patients suffer severely from nausea or vomiting, which is most readily relieved by thoroughly irrigating the stomach, through a siphon stomach tube, with normal salt solution as hot as it can be borne, up to 110° F.

The hot gastric lavage alone is sometimes shortly followed by the free secretion of urine. In other patients the same results may be obtained by giving a warm enema of one-half pint normal salt solution every hour, introducing the fluid by the drop method.

From internal remedies we have not seen much benefit in such cases, and can consequently not speak of them confidently, with the single exception of freshly prepared infusion of digitalis made from reliable leaves.

An enema of warm salt solution in quantity varying from eight ounces to one pint, to which from ten to twenty-five grains of sodium acetate has been added, frequently increases the flow of urine in these cases in which there is little or no urine excreted for some hours after the operation. This may be administered every hour at first, and less frequently later on.

The value of gastric lavage with hot normal salt solution in cases in which nausea exists is certainly very great, as it removes a quantity of decomposing mucus from the stomach and supplies fluid for the purpose of stimulating diuresis. When given as hot as can be borne and repeated frequently the patient usually begins to perspire freely during the administration of the lavage, and this in itself is of course of great benefit. Placing a canvas tent over the bed with the patient's head protruding, and filling this tent with hot air generated from a Bunsen burner, is very beneficial.

Cystic Kidney.

Occasionally a kidney containing multiple cysts is encountered. Were these in only one kidney a nephrectomy might be indicated; but as it is usually present in both kidneys at the same time, and as there is consequently not very much kidney substance left, it is not wise to do a nephrectomy in such cases, because the operation is very likely to give the patient no relief, and usually hastens his death. It seems wiser to split the true capsule of the kidney throughout its length, to peel it back on each side, and cut it away, and possibly to make crucial punctures of the superficial cysts. This will relieve the tension upon the remaining kidney tissue, it will improve the blood-supply to the kidney, and will not reduce the amount of kidney tissue.

This method has, however, not been sufficiently tried to have a position among recognized surgical operations, and we simply mention it here for want of a method we can recommend from personal experience.

If the kidney contains but few cysts these may be excised without difficulty and with safety to the patient, the defect being closed by one or two catgut sutures.

NEPHRORRHAPHY FOR THE RELIEF OF MOVABLE KIDNEY.**Clinical Case.**

The patient is a married woman, twenty-four years of age, the mother of two children, three and five years of age. She gives the following history:

Father died of pulmonary tuberculosis; otherwise the family history is good. The patient's health was good until one year ago, when she took a misstep and came down very forcibly on one foot. From that time on she suffered from a dragging pain in the right side of her back, just below the last rib. This has increased constantly. In the meantime she has also become very nervous, and has lost her former vigorous appearance. She is unable to do housework without greatly increasing her suffering. She locates her pain in the region of the right kidney. There are no digestive disturbances, no nausea or vomiting, but the patient suffers greatly from gaseous distension of the intestines.

Present Condition.

The patient is fairly well nourished; her appetite is fair; the bowels are regular. Heart, lungs and urine are normal. The right kidney can be palpated and moved beyond the median line and down opposite the anterior superior spine of the ilium. It can be carried up into its normal position, and when it approaches this point it slips into place very suddenly. When it is out of place the space which it should normally occupy is found vacant upon bimanual palpation.

Diagnosis.

The same considerations as regards the differential diagnosis may be applied to this that were applied to the previous case. The only condition with which a movable kidney can be confounded, in a case like the one before us, is a pedunculated hydrops of the gall-bladder, or a tongue-shaped projection from the right lobe of the liver, known as Riedel's lobe, or a tumor in a very movable cecum or ascending colon. Once we encountered a carcinoma of the pylorus in an extremely movable stomach which was mistaken for a floating kidney. Occasionally a gall bladder occluded by a gall stone will become distended to the size of the movable mass here found without becoming adherent. The neck of the gall bladder will become stretched and the latter may be movable in every direction. It frequently falls into a space in front of the left kidney and under the edge of the liver, with the same little jerky motion that one feels in replacing a movable kidney. The thickness of the abdominal wall will make it impossible to observe the fluctuation of the fluid contained in the gall bladder, and it may be quite impossible to make a positive differential diagnosis between these two conditions until the abdomen has been opened. Another condition which is more easily differentiated, but which occasionally causes difficulty, is a tongue like projection downwards from the right lobe of the liver, known as Riedel's lobe (mentioned above). This may be from six to eight inches in length, or even longer, and consequently its lower end can be dislocated a considerable distance. This mass is, however, continuous with the liver, and it is never quite as movable as the mass in this case, and it is always only its lower end which moves, the upper end being continuous with the liver. In our experience this condition has always occurred in patients with thin abdominal walls in whom

a diagnosis could be made after a careful examination. Should it, however, exist in an obese patient, such a definite diagnosis could probably not be made.

In this patient, the empty space which exists when the kidney is displaced is so distinct that there can scarcely be a doubt concerning the diagnosis.

Another test might be used by inflating the colon with gas by means of an air pump attached to a tube inserted into the rectum. The distended colon would pass below the mass if it were a distended gall bladder or a deformed lobe of the liver, while it would pass to the inner side of the mass if it were the kidney. This method, although theoretically of great value, is in practice useful only to confirm a diagnosis. If too much weight is placed upon this method the surgeon is likely to err in his diagnosis.

Etiology.

Aside from the traumatic cause, we have here the history of two pregnancies, which is another common cause of movable kidney. In many of these cases a chronic appendicitis, gastritis, enteritis or gall stones, or all of these, exist at the same time, and it is difficult to say whether or not there is any casual relation between these various conditions or whether their co-existence is merely a coincidence, or, again, whether they are all dependent upon an infection from the alimentary canal.

Many years ago Pawlik directed our attention to the fact that of the patients coming into his gynecological clinic of all women who did the work of laborers in the streets, upon buildings or on the farms and who had borne children, seventy-five per cent were suffering from this condition, but that of all such there were but a few in whom the amount of disturbance caused by the loose, displaced kidney was sufficient to require treatment. Our own observations have confirmed this in the study of many hard-working, foreign women who came under care for the treatment of other conditions, and in whom the general physical examination revealed the presence of this anomaly. Scarcely one per cent of all patients in whom the kidney is movable to a markedly abnormal degree require operation. On the other hand, we observe twenty cases in whom nephrorrhaphy has been performed without the slightest benefit, for each case in which the patient has been benefited by the operation.

Indications for Operation.

In the presence of an anatomical lesion which may be easily removed, to which the patient's suffering is directly referred, and wherein the sudden occurrence apparently initiated the pain, there can scarcely be a doubt regarding the indication for operation. This is especially true in patients who are not otherwise neurotic and who were in good health before the accident occurred which loosened the kidney, and in whose case there is no pending question of liability for personal injury. All of these matters must be carefully considered, because otherwise the operation must become more and more discredited.

The preparatory treatment should be the same as for ordinary abdominal sections.

Technique.

The same incision which has been described in connection with the previous case will be made, the fatty capsule opened, and the kidney brought up for inspection. It is quite normal, aside from the fact that it is so

freely movable. The pelvis is not distended and it is evidently free from infection.

So large a proportion of patients suffering from movable kidney suffer also from chronic appendicitis and gall stones that we usually examine these organs at the same time, provided the kidney is free from infection. This can be done by making a small opening in the peritoneum in front of the colon, inserting one or two fingers and palpating these organs. In this case we find the gall bladder free from disease, but the appendix, which is four inches in length, club-shaped at its distal end and constricted at its cecal end, contains a number of fecal concretions. We will bring the appendix and the lower end of the cecum out through the opening in the peritoneum and remove the former by the method described in the section on appendicitis. The opening in the peritoneum is then sutured with catgut and the operation upon the kidney is proceeded with.

The kidney is first brought out of the wound, as shown in Plate CXIV, then its capsule is split longitudinally a distance of two to three inches and loosened from the surface of the kidney a distance of about one inch, as shown in the same plate. Next a strand of iodoform gauze is passed underneath the lower pole of the kidney, likewise as shown in the same plate, and fastened to the capsule of the kidney by means of a fine catgut suture on either side. The kidney, together with the attached gauze, is then replaced in the body, as shown in Plate CXV, and the true capsule of the kidney is sutured to the fascia of the quadratus lumborum muscle by means of a number of chromicized catgut sutures, as indicated in Plate CXV. A small strand of iodoform gauze is passed down to the denuded surface of the kidney, and then the entire wound is sutured, with the exception of the space occupied by the strands of iodoform gauze. These are removed about ten days or two weeks after the operation; by which time vigorous granulation tissue will have developed, later forming connective tissue to keep the kidney in place.

Many surgeons do this operation without the use of the gauze and claim equally perfect results, hence this part of the procedure can hardly be considered absolutely necessary. It seems as though, in this case, the removal of the appendix, with its enteroliths, is likely to give the patient quite as much relief as the nephrorrhaphy. This has been borne out by our clinical observations. Patients in whom no lesion is corrected except the movable kidney, rarely make a satisfactory recovery, while quite the contrary is true of those in whom some other important lesion has been found and corrected.

The amount of displacement which we have found in this case might easily have caused an obstruction of the ureter and a consequent hydronephrosis. This may occur as a result of an acute bend or twist in the ureter. In either event simple drainage as practised in the case described will result in the contraction of the dilated pelvis of the kidney, and suspension of the kidney in its normal position, according to the method just described, will prevent the obstruction to the ureter in future; consequently a permanent recovery may be expected unless ulceration has resulted from the distortion of the ureter, and this in turn produced cicatricial constriction forming a fibrous stricture. The degree of constriction will determine the form of treatment in such cases. If the constriction is only moderate, simple drainage of the hydronephrosis, together with nephrorrhaphy, will result in a sufficient degree of relief to promise a complete re-

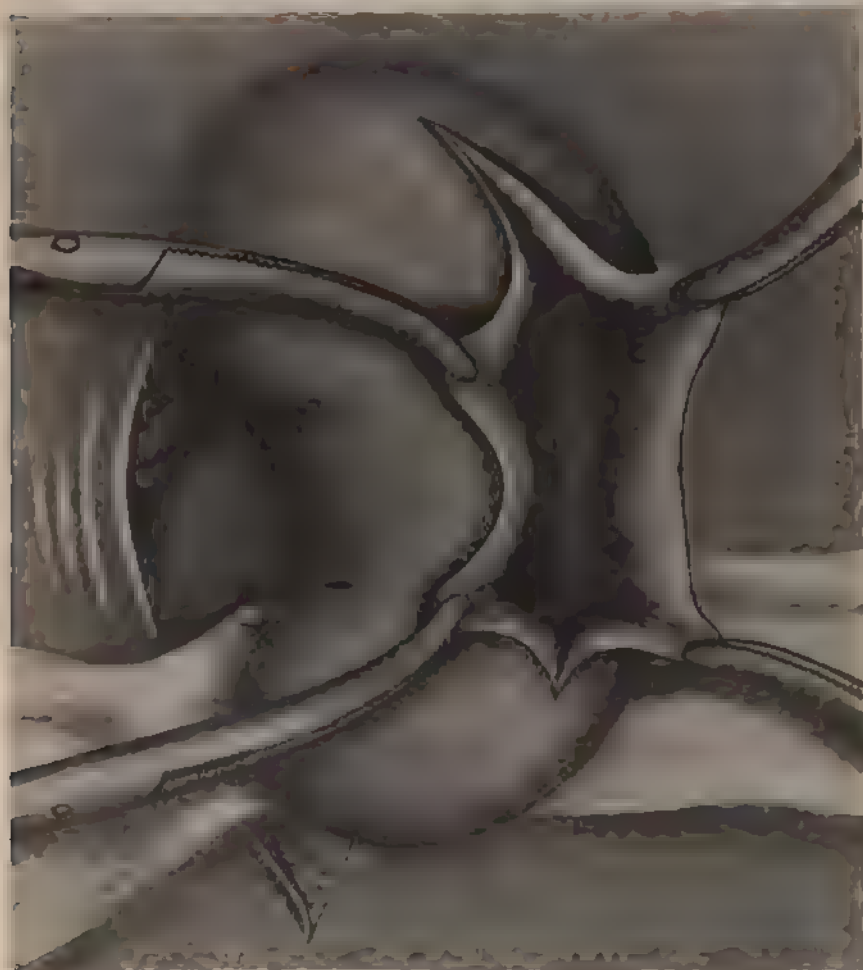


PLATE CXIV

NEPHRORRHAPHY

The wound in the lumbar region should be drawn nearly twice as long as shown in the figure. The kidney has been delivered through the lumbar incision; its capsule has been split; a piece of catgut gauze has been drawn through and beneath its lower pole and has been fastened in place by means of two sutures through the capsule. The capsule has been separated from the surface of the kidney for a distance of eight centimeters in length and three centimeters in width.

covery, because the connective tissue will become softer and the edema reduced, and consequently the passage of the urine through the ureter will become more and more free and presently all of the urine will pass in the natural way. If, however, the constriction is great, nothing less than a nephrectomy will usually suffice to give relief. It is, however, to be hoped that in the future plastic operations or resections of the ureter will yield more satisfactory results than at the present time. It is not likely that dilatation with bougies or sounds will ever accomplish much in these cases because of the difficulty one encounters in introducing bougies, the danger of rupturing the thin-walled ureter and the danger of infection. The lack of permanency of results after dilatation, which we have had abundance of opportunity to observe in the dilatation of strictures in other tubes in the body, convince us that dilatation of ureteral strictures must be looked upon as visionary in all except the neurotic. In cases of congenital or acquired deformities causing obstruction the methods already described are indicated.

PLASTIC OPERATIONS ON THE PELVIS OF THE KIDNEY.

The principal conditions requiring plastic operations upon the pelvis of the kidney are strictures of the ureter at its junction with the pelvis of the kidney, closure of the pelvis after removal of stones, and the repair of the ureter after its partial or complete detachment from the pelvis during operations upon the kidney. Even with most careful suturing of the pelvis of the kidney one is apt to have a leakage of urine. To overcome this condition W. J. Mayo has devised and put into practice a method of utilizing the fascia which is closely attached to the kidney, especially about the pelvis, as a protection to the suture lines in that part of the kidney.

In plastic operations upon the pelvis of the kidney for intermittent hydro-nephrosis with a stricture at the juncture of the ureter and the pelvis of the kidney, the operation is as follows: The fatty fascial flap is dissected back as shown in Plate CXI. A longitudinal incision is made through the ureteropelvic juncture, as shown in Plate CXI; this incision is now sutured transversely with fine catgut after the method of a Hoenike Mikulicz pyloroplasty (Plate CXIII); the fatty fascial flap which was reflected in the early part of the operation is now sutured back in place, covering over the line of suture uniting the pelvis and the ureter. Even though it can be seen that at some points the suture in the pelvis is not urine tight, yet after the fatty fascia flap is sutured over this area, primary union will usually take place without any leakage of urine.

In operating for stones in the pelvis of the kidney in patients whose kidneys are not infected enough to require drainage, the incision in the pelvis can be closed without any leakage of urine. In cases of stone in the pelvis it will usually be found that there is an increase in the fatty tissue in region of the pelvis, which is also adherent thereto. In these cases the incision is made directly through the fatty tissue and the pelvis as though they were one.

After the stone is removed, the incisions in the pelvis and in the fascia covering are sutured as a part of each other, with a row of fine catgut. If the opening in the pelvis has not been injured during the removal of the stones, this one row of sutures will usually be sufficient to prevent leakage. If the opening in the pelvis has been torn during the removal of the stones,



PLATE CXV.

NEPHRECTOMY.

The kidney has been replaced, its lower pole being supported by a strand of iodiform gauze. The loosened capsule has been sutured to the muscles and fascia in the lumbar wound.

Usually the number of sutures used in attaching the capsule to the fascia is greater than shown in this figure.

operation. Since the above was written a few years ago the method has been much lauded by some authors and thoroughly condemned by others. The prevailing opinion at the present time seems to be that in cases in which the nephritis is due to obstruction of the circulation caused by malposition of the kidney this operation, combined with nephrorrhaphy, may be of benefit. It is certain that in such cases albuminuria will disappear.

The number of these cases is so small, however, that it is not of very great importance. In connection with Dr. George Suker we were able to demonstrate that in no case in which there existed an albuminuric retinitis at the time of operation was any permanent improvement obtained.

RESECTION OF THE KIDNEY.

This operation is but rarely indicated, as the reason for which one would be likely to perform it is the removal of tumors. The kidney is so seldom the seat of benign tumors that this condition scarcely deserves consideration, the small benign cyst having been mentioned before. In malignant disease of the kidney even the complete removal of the organ promises but little; hence a resection would almost certainly be followed by a rapid recurrence. In severe crushing injuries a resection sometimes becomes necessary. In these cases the extent of the excision will depend upon the degree of the trauma. It should be in the form of a wedge-shaped piece in order to permit of the closure of the defect.

Sutures are likely to cut through the kidney tissue if applied directly, but if passed through gauze folded upon itself from two to four times, then through both edges of the wound, then again through layers of gauze, then back in the opposite direction, they can be tied without cutting. These sutures should be of catgut which will last about ten days before being absorbed. The strips of gauze may be permitted to project from the wound so as to be withdrawn when they are freed by the absorption of the catgut sutures.

The same plan may be employed after nephrotomy if the hemorrhage is so severe that it cannot be controlled by tamponing. If drainage of the pelvis of the kidney is desired, in a case in which this plan is indicated because of severe hemorrhage, one or two rubber drains may be wrapped in iodoform gauze and inserted into the pelvis of the kidney, and then the sutures applied as before, the cut edges of the kidney being thus pressed against the gauze surrounding the rubber drains.

PYELOTOMY.

In case a stone is located in the pelvis of the kidney the diameter of which does not exceed two or three cm., it can usually be removed by splitting the pelvis posteriorly in the direction of the ureter. This should of course not be done if the stone is very large, with sharp projections extending into the calices, because in such case the injury caused is much greater than it would be after splitting the kidney longitudinally. The finger should be inserted into the kidney pelvis through the opening and a careful search made for further separate stones. The stone removed should be examined to determine whether any fragment has been broken off in its extraction. The wound should be drained by a fine, soft, split, rubber drainage tube, and a few cigarette drains should be passed down to the kidney pelvis to drain the surrounding loose tissue.

In all of these cases the patient should permanently drink only distilled water, or spring water which is practically free from any mineral substances, because in this way recurrence may be prevented.

EXCISION OF THE URETER.

If the ureter is diseased in connection with the kidney, which is not uncommon in tuberculosis, it may be excised by following it from above downward. If disease of the ureter is diagnosed before the operation is begun it is better to make an oblique incision so as to carry the lower end thereof to a point near the anterior superior spine of the ilium, provided the posterior incision has been chosen. If the anterior incision has been selected it is well to split the outer edge of the rectus abdominis muscle longitudinally. This incision may be lengthened to suit the convenience of the operator. When the bladder is reached the ureter is cut off and a small purse-string suture applied to cover the stump. The wound is then closed with two or three rows of catgut sutures, unless infection has taken place from an ulcerated ureter or from pus in the pelvis of the kidney, in which event the wound should be drained with iodoform gauze above and below and the intervening portion sutured in order to prevent the formation of a hernia.

After the kidney and the ureter have been removed the suppuration will subside rapidly, even if it has not been possible to effect the removal without spilling some of the pus contained.

CALCULUS IN THE URETER.

The symptoms in this condition at the time the patient comes under the care of the surgeon usually simply consist of localized pain, but there is always a history of renal colic preceding the present complaint.

The pain may be at any point in the course of the ureter, although the calculus is practically always located at one of three points, viz., (1) at the beginning of the ureter, (2) at a point where the ureter passes over the edge of the iliacus muscle, and (3) just before the ureter empties into the bladder.

The stone may almost always be located with the X-ray, provided the intestinal tract has been thoroughly emptied by the use of castor oil and enemata, and of course provided that the apparatus and technique used are good. Occasionally a fecal concretion in the appendix may be mistaken for a renal calculus in the skiagram, and at times a calcareous phlebolith has been so mistaken. Of course if the colon has not been properly emptied hardened fecal masses may cause a shadow which will be mistaken for a calculus. Then again, at times a renal calculus may be so transparent that it will not cause a sufficient shadow to be recognized on the plate.

Ordinarily, however, this method of diagnosis is eminently satisfactory.

Treatment.

An abdominal incision is made directly over the seat of the stone, according to the plan for abdominal incisions as indicated in Plates XIII and XIV. The peritoneum is split longitudinally over the ureter then the latter is lifted into view and the surrounding area tamponed away with moist gauze pads, then a longitudinal incision is made once and a half the length of the diameter of the stone and directly over the most prominent portion thereof.

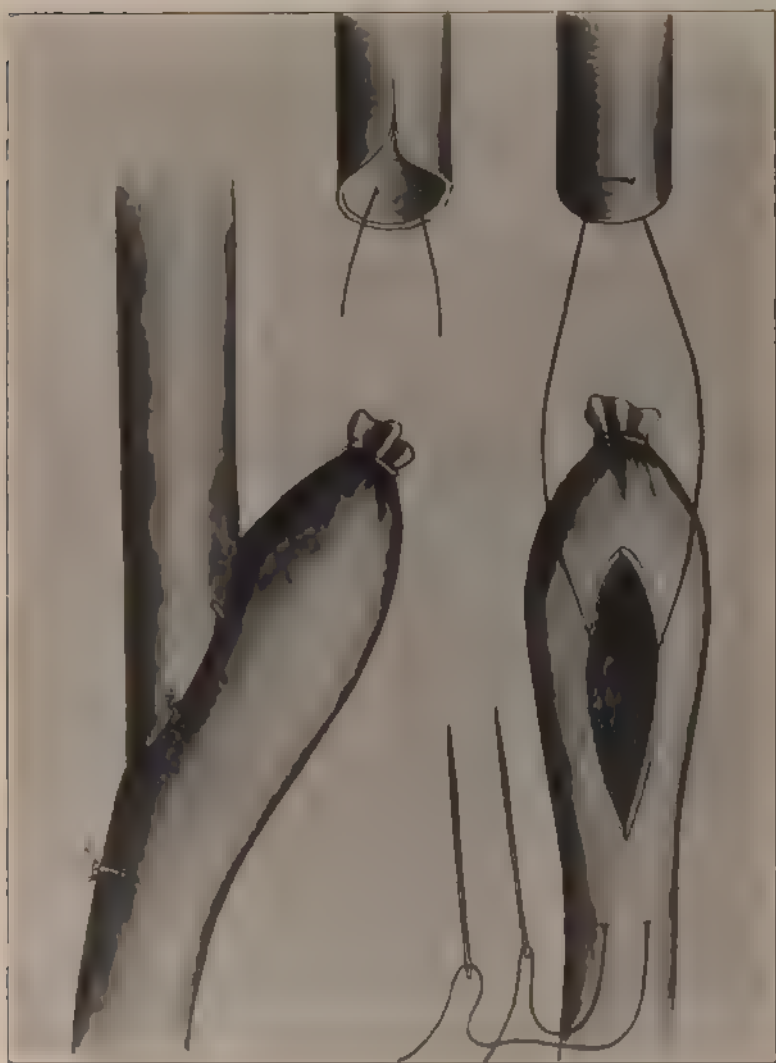


PLATE CXVI

Anastomosis of the ureter by Van Hook's method

in order that the stone may be removed without crushing or tearing the wall of the ureter. The stone is then lifted out and the edges of the wall of the ureter permitted to fall together. A rubber drainage tube with a notch cut out of its lower end is now placed down upon the ureter at the point of the opening and held in position by a fine catgut suture, then this tube is surrounded by four or five cigarette drains which are all permitted to pass out of the abdominal wound with the rubber tube.

Should the ureter be enlarged above the point at which the stone was located the rubber tube is carried into the lumen of the ureter, but if there has been no obstruction this is not necessary.

SECTION OF THE URETER.

Van Hook Operation.

If the ureter is cut during an operation, except in cases in which this is done for the removal of a malignant growth, an attempt should be made to repair the damage immediately. If the section is at any point more than a few cm. distant from the bladder it is best to telescope the upper segment either directly into the lower segment or through a lateral incision, according to the method introduced by Van Hook. This operation consists in passing a probe into the upper end of the lower segment and cutting down upon this probe one and one-half cm. lower down, making a lateral slit 5 mm. in length, then ligating the upper end of the lower segment, then a fine silk suture is passed through one edge of the lower open end of the upper segment, then both threads are threaded in one needle which is passed up the lumen of the lower segment through the lateral slit and out through the opposite wall one cm. beyond the distal end of the lateral slit. Thus the lower end of the upper segment is telescoped into the lumen of the lower segment through the lateral slit. The edges of the slit are carefully sutured to the side of the upper segment as shown in Plate CXVI.

In case the section has occurred within a few cm. of the bladder the ureter is laid bare and loosened for a distance of two cm., then a convenient point is chosen in the wall of the bladder and after making a slit in the peritoneal covering the bladder wall is tunneled obliquely with a trocar. The end of the ureter is then split in halves at its distal end and each half transfixed with a fine silk suture both ends of which are then threaded upon a needle. These needles are passed through the opening made by the trocar separately and then the wall of the bladder is transfixed one cm. to each side of the trocar opening, as shown in Plate CXVI.

In order to make the next step possible a sound is passed into the bladder and its end is engaged in the open end of the canula of the trocar which is in the bladder and as the canula of the trocar is withdrawn the end of the sound is passed out through the wall of the bladder. The open end of the ureter is then threaded upon this end of the sound and as the latter is again drawn into the bladder the end of the ureter is slipped in with it, when the two threads are drawn taut and tied. The bladder wall is sutured with a few very fine catgut stitches to the side of the ureter and the peritoneum is closed over all. A retention catheter is inserted and the patient is given half a pint of distilled water with five drops of dilute aromatic sulphuric acid every two hours.

A soft rubber drainage tube and several cigarette drains are passed down to the point of anastomosis and out of the lower angle of the wound.

lignant growths it seems better to employ this plan until the latter class of cases has definitely demonstrated the safety of the oblique implantation of the ureters into the sigmoid.

Of the various methods which have been recommended that described above seems to promise the greatest safety.

EXSTROPHY OF THE BLADDER.

The condition of exstrophy of the bladder is so distressing that we describe an operation which promises to become generally adopted, although our personal experience is still too limited to warrant recommending it on that ground alone. The entire number of cases which have been operated by this method is also quite small, and in many of them the ultimate result has not been reported, but all the operations which were in use before the introduction of this one can be applied in only a small number of patients and do not promise very satisfactory results at best, while this procedure seems so far to be most satisfactory.

Since the above was written we have performed the operation six times with five recoveries, one patient having died from peritonitis. Another patient died two years later from strangulated hernia, two are still well and two others have not been heard from and the sixth case died from nephritis. The physician caring for the patient considered it a case of septic nephritis due to ascending infection. The death occurred after an illness of a few weeks and after the patient had been well for five years following operation.

Preparation for Operation.

Two days before the operation the patient is given two ounces of castor oil, in order to remove as much of the mucus and other contents of the alimentary canal as possible with slight irritation. From this time on until the operation is performed, the patient is given only concentrated sterilized food, so as to leave the alimentary canal in as nearly an aseptic condition as can be. No enema is given until the patient is anesthetized; then the rectum and colon are very thoroughly irrigated with boric acid solution, and after the water returns perfectly clear the sphincter ani muscles are stretched gently, but very thoroughly. Then the rectum is once more thoroughly irrigated. The patient is placed in the Trendelenburg position and the bladder is carefully disinfected.

Mydl's Operation.

The bladder is loosened from the abdominal wall throughout the entire distance, two fine probes are inserted into the ureters, great care being taken not to disturb the little valve-like openings at the end of the ureters. Then an elliptical portion of the bladder wall, from two to three centimeters in diameter, is excised in such a manner that the openings of the ureters are as near the middle of this portion as possible. Care must be taken in this step of the operation not to injure the ureters. It is best to begin the incision below and then lift up the portion of the bladder and to observe the direction in which the probes extend into the ureters. In this manner injury to the latter is readily avoided. The segment of the bladder, together with the ureters, is now held upwards, the urine which issues from the ureters is sponged gently, and the remaining portion of the bladder is rapidly dissected away. Then the sigmoid flexure is brought up into the wound and a longitudinal incision made through the middle of the longitudinal muscu-

lar band, two centimeters in length. The segment of the bladder is inserted into the colon and held in place with four silk stitches, two at the end of the longitudinal incision in the colon and one in each edge of the incision half way between these two stitches. Four sutures are previously placed in the wall of the colon, one on each side of the middle of the incision and one just beyond the end of the incision, to be utilized for the purpose of manipulating the intestine while the segment of the bladder is sutured in place. The first row of sutures is passed through the entire thickness of the bladder and through the entire thickness of the intestine, care being taken to repeat about the fourth stitch in the continuous suture in order to prevent slipping—after the manner described in the section on intestinal surgery. After the entire segment of the bladder has been sutured into this opening, with the mucous membrane facing the lumen of the intestine, a second row of sutures is applied which penetrates neither the portion of the bladder nor the intestine, but simply grasps a sufficient amount of tissue to bring the serous surfaces carefully and thoroughly in apposition throughout the entire course. The intestine is then dropped into the abdominal cavity. Care must then be taken to isolate the layers of the abdominal wall because the latter is bound to be defective in these cases, and if this precaution is not taken a ventral hernia is very likely to result. This condition later resulted in the formation of a strangulated hernia in one of our cases which eventuated in the death of the patient. After these layers have been carefully isolated the abdominal wall is closed in the manner described in the section on abdominal surgery.

It is of great importance in these cases to strap the wound thoroughly with rubber adhesive straps, in order to remove the tension as much as possible from the stitches in the abdominal wound. It is also important to administer for the first two weeks after the operation only such food as will give rise to the formation of as little gas as possible, in order to reduce the strain upon the stitches of the abdominal wound to a minimum. The stretching of the sphincter ani muscle in the beginning of the operation will aid in preventing accumulation of gas and will reduce the pressure upon the wound in the intestine. Should, however, the sphincter contract sooner than desirable a rectal tube should be inserted and kept freely open, in order to prevent the accumulation of flatus in the rectum.

These patients are very comfortable after the operation. They are able to remain perfectly dry, sleep all night and evacuate the urine from the rectum as often as they would normally evacuate the bladder. They are no longer offensive to themselves or their friends and neighbors and they and their families look upon the operation as a great blessing.

It is important not to injure the ostium of the ureter, and for this reason the probes which are used for marking the location of the ostium and of the ureter during the operation should be manipulated with great gentleness. It is undoubtedly bad practice to leave ureteral catheters in place for several days after the operation, as recommended by some surgeons, because this would surely injure the delicate valve-like openings.

Were it not for these delicate structures it seems unlikely that the operation could have proved satisfactory, although the oblique submucous implantation of the ureters may prove to be satisfactory in time.



PLATE CXVII

REMOVAL OF PENIS AND SCROTUM FOR CARCINOMA.

With excision of inguinal lymphatics and transplantation of stump of urethra into perineum showing primary incision



PLATE CXVIII.

COMPLETE EXCISION OF MALE GENITALIA FOR CARCINOMA OF PENIS

1, urethra, 2, vascular portion of penis, 3, vessels of cord, 4, vas deferens
 Showing urethral stump transplanted into perineum through buttonhole, the end
 projecting 5 mm.





PLATE CXIX.

COMPLETE ENCISION OF MALE GENITALIA

Together with inguina lymphatics and with transplantation of stump of urethra into perineum through button hole in skin 1, urethra, 5, fascia of internal oblique abdominal muscle, 6, internal oblique abdominal muscle; 7. Poupert's ligament



PLATE CXX

COMPLETE EXCISION OF MALE GENITALIA FOR CARCINOMA OF PENIS

Together with excision of lymphatics of inguinal region and transplantation of stump of urethra into perineum through button-hole in skin. Operation completed.

PLASTIC OPERATIONS FOR CLOSING THE EXSTROPHY.

In performing a plastic operation for the purpose of closing an exstrophy of the bladder everything depends upon the amount of tissue that is lacking and the portions involved. Each operation must be planned with a view to the formation of a bladder lined with mucous membrane, that will hold the urine or that will serve to direct the flow of urine into a rubber urinal. If possible a urethra should also be constructed. Usually several operations are required and then the results are as a rule only slightly satisfactory.

Of the plastic operations we have obtained the most satisfactory result in a case in which we utilized the mucous membrane of the trough-like urethra in a case of hypospadias for the construction of a urethra which we passed out through a large trocar puncture in the urethra. We then made an incision between the mucous lining of the bladder and the skin and then closed the defect by bending the pieces upward and suturing into this defect. A retention catheter was placed into the bladder through the new urethra and aromatic sulphuric acid in distilled water was given every two hours. The patient made a very satisfactory recovery.

The boy was only six years old and the operation was performed but one year ago. How the organ will functionate later in life is of course of much interest.

AMPUTATION OF THE PENIS.

This operation is done only for the relief of malignant growths which, in our experience, have always been carcinomatous in nature, although there is no reason why other forms of malignant growth should not occur in this organ.

If the disease is confined to the distal end, it may be so circumscribed as to be completely removable by the amputation of only a portion of the organ, but if any doubt exists it is much safer for the patient to make the complete amputation at once, together with a thorough removal of the inguinal lymphatic glands.

If the condition present seems to warrant the removal of only a portion of the organ, the following method should be employed:

A small rubber tube is stretched and passed several times around the penis near its pubic attachment and then tied, in order to make the operation bloodless. A point is then chosen sufficiently far from the tumor to insure freedom from invasion. Usually this distance should be at least five centimeters; and the greater the distance the better, as these growths are exceedingly prone to recur in this region. After the point for amputation has been chosen the skin is divided with a circular incision two centimeters nearer the pubis. Then a sound is introduced into the urethra and a catgut suture is passed around each corpus cavernosum, and another around the corpus spongiosum down to, but not through, the urethra, which may be determined by the presence of the sound in the canal. These ligatures are carefully tied. Then a circular incision is carried down to, but not through, the urethra, one centimeter away from the point at which the ligatures have been applied, in a distal direction. Then the tissues are stripped from the urethra for a distance of one centimeter in the distal direction, and then the urethra is severed.

The dorsal artery is now caught separately with hemostatic forceps and ligated. Then the elastic constrictor is removed and the stump will be found entirely free from hemorrhage. The projecting portion of the urethra is then split laterally, and carried through a buttonhole in the anterior skin flap, where it is sutured in place with horse-hair sutures. The skin is then drawn over the stump of the penis, and a tenaculum is applied on each side, thus forming a transverse wound. The edges of the skin are united and a complete covering of the stump is formed in this manner. The arrangement of the flaps at the end of the urethra will prevent the contraction of the canal at this point.

This operation leaves the patient in a very comfortable condition, but unfortunately these sufferers do not come under the care of the surgeon early enough, as a rule, to make the procedure justifiable. Unless the case is absolutely incipient we never advise this operation, because it is almost always followed by recurrences, and unfortunately in the recurrent cases the disease has often advanced so far that complete excision is no longer possible, while if the extensive operation described below is done fairly early the relief is very likely to be permanent.

Fortunately the more complete operation gives satisfactory results, both as regards permanency of cure and function of the urethra, even in advanced cases. This operation is, however, much more extensive and correspondingly more severe as regards the production of shock. It contemplates the removal of the entire organ, together with the scrotum, with its contents, and the tissues of the spermatic cords, as well as the inguinal lymphatic glands. It also includes the transplantation of the remnant of the urethra into the perineum.

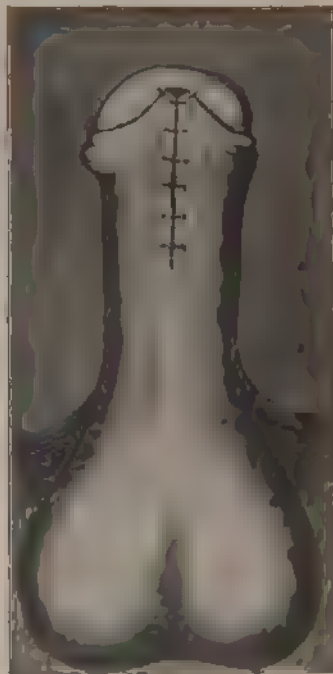
Technique

An incision is begun opposite the internal abdominal ring on one side. It is carried down over the center of the inguinal canal around the edge of the scrotum, sufficient skin being left to insure the covering of the entire defect. Then the incision is carried up on the opposite side along the edge of the scrotum over the inguinal canal to a point opposite the other internal abdominal ring. A transverse incision is made to join the two here described, just below the pubis. The skin and superficial fascia are then dissected up and all the inguinal lymphatic glands carefully excised. The tissues of the cord are then isolated and treated as described in the operation for castration. The bleeding vessels are carefully caught with hemostatic forceps, in order to reduce the loss of blood to a minimum. It is desirable to make a very thorough dissection of the entire inguinal region, so that no infected lymphatic glands remain. The suspensory ligament is severed from its attachment to the pubic bone and then the crura are loosened from their attachments to the rami of the pubes.

It now becomes necessary to insert a sound into the urethra, and the latter should be dissected out to a length so as to project half a centimeter beyond the level of the lateral skin flaps. After isolating this length of urethra it is cut off at right angles, and now the remaining tissues are loosened from their attachment backward. The branches of the internal pubic arteries should be caught before they are severed, because quite a little blood may be saved in this manner. All the blood vessels are then carefully ligated. The remnant of the urethra is split anteriorly and posteriorly to a distance of one-half centimeter, and is sutured directly into the



I



II

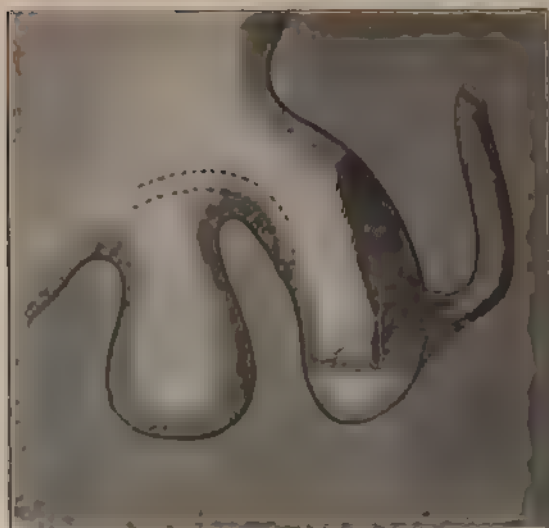
PLATE CXXI

HYPOSPADIAS OPERATION

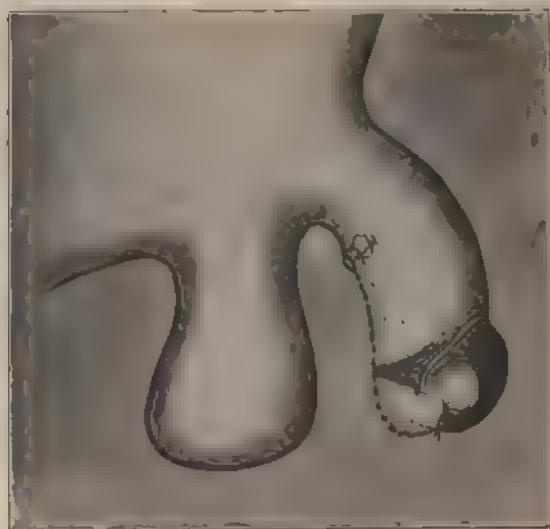
Fig. 1 represents the flaps of the foreskin reflected; the urethra carefully dissected free; a perforation has been made through the glans by means of a trocar, the end of the urethra has been caught with fine pointed hemostatic forceps and carried forward through the opening in the glans.

Fig. 2 represents the flaps sutured in place, making an artificial frenulum, the end of the urethra having previously been sutured in position a little above the center of the glans.

Taken from Dr. C. H. Mayo's original drawings.



I



II

PLATE CXXII

HYPOSPADIAS

Fig. I represents the prepuce and a portion of the skin from the dorsal surface of the penis dissected up in order to form a canal, with the cuticle turned in for a lining. The urethra is indicated by dotted lines. It opens on the inferior surface of the penis.

Fig. II represents the glans and the penis tunneled and the newly formed urethra drawn through and the defect upon the dorsal surface of the penis closed with sutures.

Taken from Dr. C. H. Mayo's original drawings.



(a)



(b)

PLATE CXXIII
C H Mayo method



(c)



(d)

PLATE CXXIV.
C H Mayo method



(e)

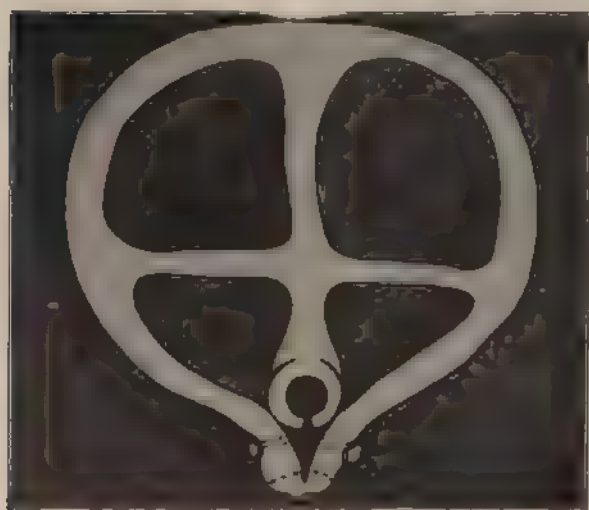


(f)

PLATE CXXV
C. H. Mayo method



(g)



(h)

PLATE CXXVI
C. H. Mayo method

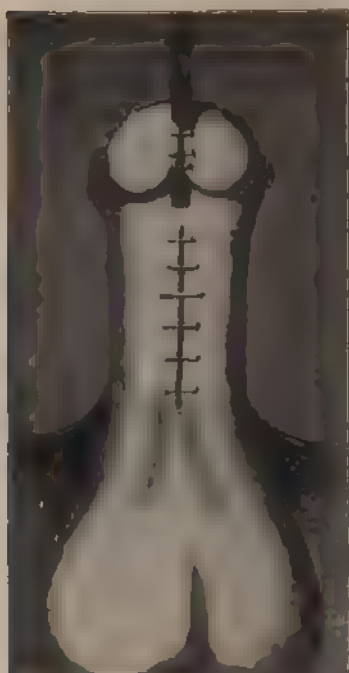


(i)

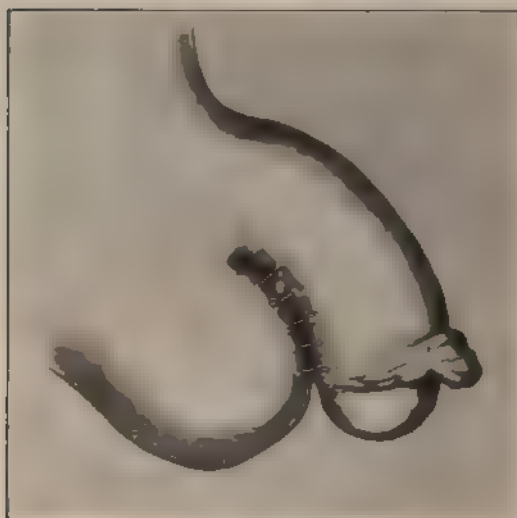


(ii)

PLATE CXXVII.
C H Mayo method



(k)



(l)

PLATE CXXVIII
C. H. Mayo method

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(m)

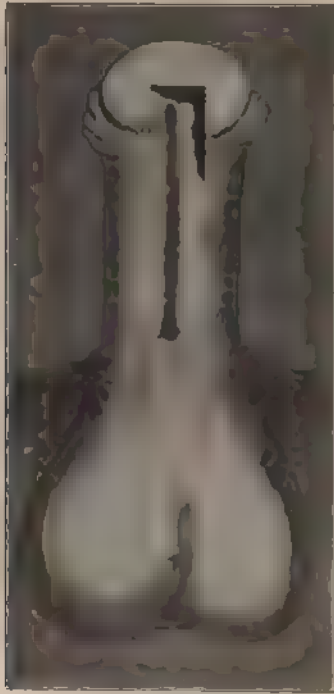


(n)

PLATE CXXIX.
C. H. Mayo method



(a)



(p)

PLATE CXXX
C H Mayo method

lower edge of the wound in the perineum. A small retention catheter is introduced into the bladder and the incisions in the skin are closed throughout with sutures. If the dissection in the inguinal region has been quite extensive it is well to insert a small split rubber drainage tube on each side, in order to prevent the accumulation of serum. Ordinarily, however, the application of thoroughly fitting pads will make this unnecessary. An ordinary dressing is applied to the wound and a retention catheter is attached to a rubber drain, which is inserted in a bottle containing some antiseptic fluid.

This operation is usually performed in aged patients, and consequently it is important that it should be done quickly and that as little traumatism as possible be inflicted.

After-Treatment.

We have found it advantageous to permit these patients to sit up soon after the operation, on the second or third day, because this will not interfere with the healing, and because they are prone to hypostatic congestion, which can be avoided in this manner.

The retention catheter is removed on the second or third day and the patient permitted to evacuate his bladder spontaneously. In some cases we have permitted this from the beginning with perfect satisfaction.

Prognosis.

Our personal experience with this operation has been confined to six cases, all of which had been previously operated for the relief of carcinoma, and in all of them there was not only a recurrence of the disease in the organ, but also a recurrence in the inguinal lymphatic glands. To our surprise, none of these patients has died as a result of a recurrence. The first patient lived for three years and died of pneumonia. The second lived for a period of six years without recurrence and died of an intercurrent disease. The third is alive after eleven years; the fourth we have lost sight of; the fifth is well after five years, and the sixth is too recent to be of any importance in this consideration, the operation having been performed not much over one year ago, but he, also, is free from recurrence. In all of these the operation was done with the greatest thoroughness, although each case at the time of the operation seemed hopeless, judging from the experience with carcinoma in other regions of the body after the lymphatic glands have been involved. In all of these we employed the X-ray in the after-treatment with the exception of the first case.

HYPOSPADIAS.

This deformity is so common that it seems proper to describe a simple method for its relief, especially as the presence of the defect seems to give rise to much mental suffering on the part of the parents of the afflicted child.

The urethra may open just at the beginning of the glans and then the operation to be employed is exceedingly simple. It was primarily described by Carl Beck.

An incision is made through the skin in the median line from its opening to a point from one-third to one-half the distance to the scrotum. Skin flaps are then dissected to either side, as shown in Plate CXXI, Fig. 1. The urethra is then dissected perfectly free this entire distance back, great care

being taken not to injure its delicate wall at any time. The glans is then transfixcd in the direction of the urethra by means of a very sharp trocar three millimeters in diameter. Caution should be taken to place this opening two or three millimeters above the small dimple in the center of the glans, which marks the point at which the meatus was normally intended, because if this is not done the organ will curve downward and there will still exist an uncomfortable deformity.

A pair of fine hemostatic forceps is then passed through the canal which has been made in the glans in this manner and the urethra is drawn through the opening in the manner shown in Plate CXXI, Fig. 1. It is then carefully sutured in place with two rows of catgut or fine silk sutures. The lateral skin flaps are then united as shown in Plate CXXI, Fig. 11. In this manner the deformity can be almost completely corrected and the functional conditions are very greatly improved. The tissues in this region are so elastic that they readily accommodate themselves to these new relations, and the results of this operation are very satisfactory.

In case the urethra opens far back from the glans, another method is indicated which will supply a new urethra artificially formed out of the tissues of the prepuce, as shown in Fig. 1 and 11, Plate CXXII."

The prepuce in cases of hypospadias is usually redundant and situated on the dorsal surface, overhanging the glans like a hood. The skin of the penis is noted for its thinness, having no adipose tissue, also for its looseness of attachment and elasticity. Where it is folded upon itself at its cervical attachment its character very nearly resembles mucous membrane.

The prepuce is extended as for circumcision, and two incisions are made, about one inch apart, extending from its free border to its attachment at the penile cervix; the prepuce is unfolded, forming a loop of thin skin about six centimeters in length. Should this not be considered sufficient to reach from its attachment to the hypospadiac opening, the two incisions are extended back along the dorsum of the penis until sufficient tissue is obtained, when the two incisions are connected by a transverse one, and the flap of the skin lifted, but left attached to the cervix by the inner surface. Several sutures now close the lateral integument of the penis over the denuded area. (Plate CXXII, Fig. 1.)

The pediculated flap of prepuce is constructed into a tube with its skin or outer surface inside, by means of a number of catgut sutures. The penis is tunneled by means of a narrow bistoury or medium trocar and cannula, through the glans, above its groove, along the penis to a point beneath the hypospadiac opening, when it is made to emerge at one side of, but close to, the urethra; the tube of prepuce is drawn through the tunnel and sutured where it enters the glans and also where it emerges. (Plate CXXII, Fig. 11.) At the end of ten days the flap of pedicle is cut through close to the new meatus. The second operation, made at a later period, consists of a perineal opening into the urethra and insertion of a Jacobs' self-retaining female catheter; this is the least irritating and can be left as long as needed, usually from five to eight days. An incision at the termination of the two urethras now admits of accurate coaptation by sutures, or the normal urethra may be mobilized to a sufficient extent to admit of its insertion into the caliber of the new urethra, where it is held by sutures and the external parts closed over this. Occasionally a little urine escapes into the urethra and the entire canal is best drained by passing several silk-worm strands of horsehair through the urethra and out alongside the ca-

theter in the perineal opening. When union of the canals is complete the drains are removed and the perineal drainage will usually close itself in a few days. Horsehair and fine catgut have proved the best suture material for this form of plastic work.

The advantages of this combined operation are:

Advantages.

1. A urethral tube of thin, elastic skin, nearly approaching mucous membrane, yet having no hair surface to occasion later complications.

In performing this operation it is especially important to bear in mind the following point: A sufficiently large flap must be made to provide a urethra that will reach without tension.

2. The trocar opening through the body of the penis must be very large, in fact so large that the circulation in the new urethra will not be interfered with after the organ becomes edematous.

3. A perineal drain for the bladder, with a self-retaining Jacobs' female catheter, must be employed.

4. A silkworm drain for the urethra should always be inserted.

This method is capable of application to the worst types of hypospadiac cases.

If there is a marked groove in the penis, indicating the fact that the lack of closure of the canal depended upon a very small defect, a method which was most perfectly described and illustrated by C. H. Mayo will be found most useful.

Methods of C. H. Mayo.

Plates CXXIII and CXXIV (a) show the original incisions, which are not nearly as far apart near the glans penis as they must be in order to secure an ample urethra. At (b) the lower flap is dissected up, which is presently to be utilized for covering the urethra formed of the upper portion. At (c) this urethra has been formed by suturing the free edges with fine catgut. At (d) the lower flap has been sutured upward, twisted 180 degrees upon its pedicle and its edges have been sutured to the edges of the wound from which the tissue was cut to form the urethral canal.

CXXV and CXXVI illustrate another equally ingenious method which has the advantage of not using long flaps, but the disadvantage of subjecting the tissues to a certain degree of tension, although this may be relieved in a measure by making a longitudinal incision through the skin on the dorsal surface of the penis from the glans to the pubis. At (e) the flap is being cut and elevated to produce the new urethra; at (f) this is further developed, showing also the perforation of the glans; at (g) the new urethra has been covered by the lateral flaps and in order to relieve the tension from these a row of mattress sutures has been applied, because without these the line of suture invariably opens. (h) represents a cross-section of the penis after all sutures have been applied.

The mattress sutures are tied rather loosely over a fine rubber drainage tube at each edge in order to allow for the edema which always appears.

Plates CXXVII and CXXVIII illustrate still another method applicable to cases of very slight degree, as shown at (i), where the urethra reaches to the base of the glans, or in cases as shown at (j) in which the urethra can be mobilized and brought forward, the glans being perforated so that the end of the urethra will open at the proper point. In this operation it is again

important to make ample flaps so short there will be no tension. At (k) this operation is shown as completed.

Another ingenious plan is represented in Plate CXXVIII (l), in which a flap has been cut in the scrotum just sufficient to make the inferior lining of the urethra. This is sutured into two incisions, forming a flap which will make the anterior half of the urethral lining. After perfect union has been accomplished this flap is dissected up, leaving the urethra closed. The new surface formed may be covered with a long narrow skin graft, or it may be permitted to become covered with epithelium from the edges.

The objection to this method lies in the fact that occasionally a few hairs will grow in the part of the urethra formed from the flap taken from the scrotum, and the earthy phosphates contained in the urine are likely to collect on these hairs.

In many cases the penis is curved downward because of the shortness of the skin and fascia on the inferior surface. To overcome this deformity a transverse incision may be made through all of the tissues that bind the organ and then the wound can be spread lengthwise, as at (m) Plate CXXIX.

Almost innumerable methods have been practised, as suggested by the conditions present in the particular case under consideration: at (o) Plate CXXX is represented an ingenious plan of arrangement which prevents the incision in the urethra, and that in the skin, from coming opposite each other.

In all of these operations it is well to make a perineal urethrotomy through which a retention catheter is inserted, which is kept in place until the wound has healed. Neglecting to take this precaution usually, or at least frequently, results in failure.

While the retention catheter is in place it is important to give a small amount of aromatic sulphuric acid, or some other mineral acid, in distilled water every two or three hours to prevent the accumulation of earthy phosphates in the catheter. The dose must, of course, be regulated according to the age of the patient.

Another precaution which it is important to take into account in all of these operations is the fact that in many cases a satisfactory ultimate result can be obtained much sooner if the operation is carried out in a number of stages, and if these stages are not hurried, as one frequently loses much that has been gained by a little too much haste. One must also bear in mind the fact that considerable edema is to be expected and that consequently due allowance must be made for this in order to prevent the occurrence of pressure necrosis, which would otherwise result from the additional tension caused by the edema.

Again the principle that to obtain satisfactory results from operations for the correction of deformities we must overcorrect them, is illustrated strikingly in this operation.

VARICOCELE.

This condition is found mostly in boys above the age of sixteen.

Classes.

There are three distinct classes under which all patients may be distributed from a clinical standpoint. In the first there are no symptoms; the patient discovers the deformity by accident or it is recognized by his physician incidentally. In the second class the patient has suffered severely from

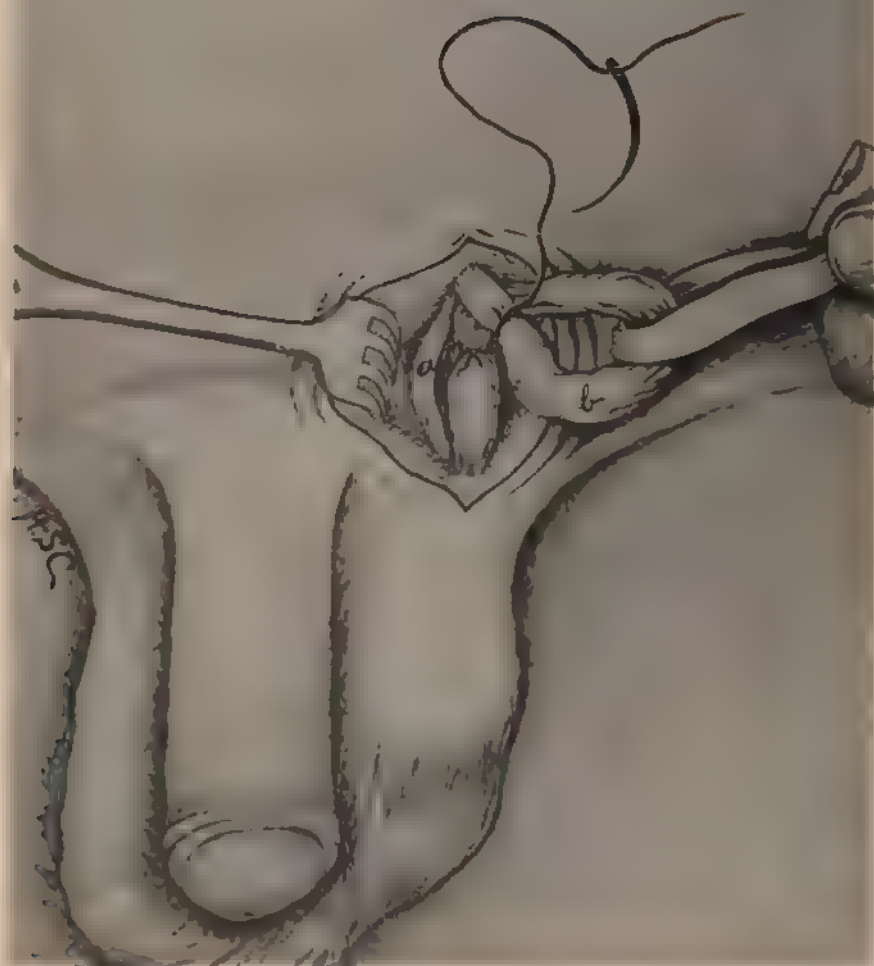


PLATE CXXXI

VARICOCELE OPERATION

a vas deferens, *b* varicose veins the two stumps being sutured together with catgut suture *c* elevate the testicle in left side of the scrotum

a dragging pain in the left side of the scrotum, extending into the groin and frequently into the back. This pain is increased when the patient is compelled to stand at his work or lift heavy weights. It is also much more severe when he is tired, especially during warm weather. This is a marked feature of varicocele, that the number of cases regularly increases in our hospital service with the approach of warm weather and decreases in winter. In the third class the patient is neurasthenic and has attributed many forms of mental and physical suffering to the varicocele. He may suffer physically in the same manner as the patient in the second class, but the prominent symptoms are those of neurasthenia.

Diagnosis.

There is a marked difference upon palpation in the right and left half of the scrotum. On the right side can be distinguished a hard, cord-like structure—the vas deferens—extending the entire distance of the scrotum, with the testicle located at its lower end. On the left side these structures are almost concealed by a large accumulation of elastic, worm-like structures coiled upon themselves, giving rise to the sensation which has been compared to the manipulation of a number of angleworms. This is due to the great dilatation of the spermatic veins, which are in a varicose condition.

If the patient is placed in the recumbent position the veins become empty and can no longer be felt unless the affection has existed for a long time, in which case the walls of the veins themselves will have become thickened in the natural tendency of compensation, and then the change in the fullness of the vessels will not so completely alter the impression upon palpation.

Very rarely the condition is present upon both sides, and still more rarely upon the right side alone, because the anatomical difference of the two sides favors the formation of varicocele upon the left.

The malady is so characteristic that it is not likely to ever be confounded with any other.

Indications for Operation.

In the first class the operation is plainly not indicated as in itself the condition is harmless so long as it gives rise to neither pain nor discomfort. It neither causes any other pathological state nor does it predispose to any; hence there can be no good reason for surgical procedure. In these cases it may be proper to advise the wearing of a well-fitting suspensory bandage, which will tend to prevent the further dilatation of the veins.

In the second class surgical treatment is strongly indicated, because, if properly executed, it will result in permanent relief in almost every case. It can be performed with safety to the patient, and it will disable him from work only for a very short time.

In the third class it is necessary to determine whether there is any possibility of casual relation between the varicocele and the neurasthenia. If such a relation can be established the operation is plainly indicated. If there is as plainly no relation between the two, then the operation is not called for unless there seems to be reason to suppose that the presence of the deformity causes undue anxiety in the mind of the patient, which in turn causes or increases his neurasthenia. In such event the removal of the deformity might remove at least one cause of the neurasthenia.

If there is doubt in these cases it seems but fair that the patient be

given the benefit thereof, and that surgical relief of the pathological condition be employed.

Technique.

An incision three to four centimeters in length is made directly over the spermatic cord downward from a point just below the external abdominal ring. The blood vessels which appear in the incision are either caught at once between two pairs of hemostatic forceps and then cut, or the incision is made directly down to the tissues of the spermatic cord and the bleeding points thus caught with hemostatic forceps.

It is important that throughout this operation all bleeding be carefully controlled, in order to prevent infiltration of the tissues with blood or the formation of a hematoma, for both of these states are exceedingly annoying, not so much on account of their inherent importance as because of the anxiety they produce in the patient.

The cord is then brought up into the wound and the vas deferens, with a few of the accompanying small arteries and veins, isolated. This leaves the great mass of varicose veins in a separate bunch. After carefully carrying this separation from the external abdominal ring to a point half an inch from the testicle, the mass of veins is transfixed above and below with a double cat-gut ligature and tied in halves. The intervening portion is then cut away, caution being taken to leave a sufficient amount of tissue beyond the ligatures to prevent slipping. The two stumps are then united with cat-gut sutures to prevent the dragging down of the testicle, with its subsequent discomfort.

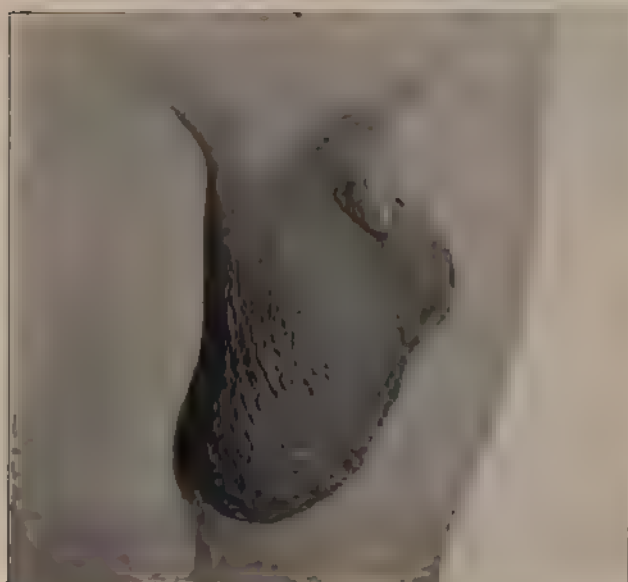
There is some danger of shortening the cord too much so that the testicle will be drawn up close to the external abdominal ring. This does not give rise to any pain, but the deformity may cause an increase in the neurasthenic condition of the patient. If possible the testicle on the operated side should hang only a little higher than the opposite one. It is quite important to have the result both cosmetically and anatomically as nearly perfect as possible.

The deep fascia is then sutured with fine cat-gut, and later the skin. It seems best to suture the fascia separately in order to prevent the infection of the deep tissues from the skin. An ordinary gauze dressing is applied to the wound and held in place with a suspensory bandage. The wound usually heals within a week, and the patient is able to perform ordinary work in two weeks. This is a very satisfactory operation as a rule, because it is thoroughly appreciated by the patient.

If one approaches the testicle too closely in the operation the resulting irritation is likely to cause the formation of a hydrocele. In order to prevent this in any case in which there seems such a likelihood, it is best to split the tunica vaginalis, evert it and suture it in the everted position before replacing the testicle in the scrotum. In cases in which this has not been done, and in which a hydrocele does occur after a varicocele operation, the injection method for the treatment of hydrocele (to be described directly), usually gives immediate and permanent relief.

HYDROCELE.

This may affect either the tunica vaginalis of the testicle, or of the spermatic cord, or both



Hydrocele.



PLATE CXXXII

Encysted hydrocele of the cord extending upwards and forming a large tumor in the abdomen a Upper limit of abdominal Tumor



Fig. 25.
The Wyllys Andrews Method.

The change is usually attributed to an acute trauma, or there may have existed an orchitis due to a specific urethritis. The physician is usually not consulted until the tumor has attained so great a size that its weight gives rise to discomfort, and it may annoy the patient on account of the deformity, or it may even interfere with locomotion. It is usually, but not always, unilateral.

Diagnosis.

Aside from the rare occurrence of sarcoma so soft in structure as to simulate fluctuation, the only condition with which hydrocele can be confounded is scrotal hernia. This is true especially in children in whom the contents of a hernia frequently give the same impression on palpation as the liquid contained in a hydrocele. This is especially true in hydrocele of the cord, which is located in the lower end of the inguinal canal and which can frequently be reduced through the inguinal canal into the peritoneal cavity. There is, however, this difference, viz., hydrocele will always reduce as a solid mass, only to reappear in a few moments without regard to the form of truss that may be applied, while hernia will give the sensation of being composed of loose substance, and it will remain reduced if properly supported by a truss.

In hydrocele of the tunica vaginalis the *light* test is the most reliable. A small tube is applied to the side of the scrotum, then a light is placed upon the opposite side. If the light is seen through the tube it is an indication that the mass is composed of a sac containing transparent fluid. However, it sometimes happens that the hydrocele is so thick-walled in old patients that no light will penetrate. Occasionally the fluid may not be transparent, being discolored by blood pigments, and then the light test may be misleading. A very simple test consists in grasping the scrotum, directly above the mass, between the finger and thumb. If the tissues of the cord can be plainly distinguished the case is one of hydrocele; if not, it is a hernia.

Abscesses may be distinguished by the evidences of inflammation; edema of the scrotum, because of edema elsewhere in the body. Tumors of the testicle are usually hard, and do not fluctuate.

Occasionally in old patients in whom the hydrocele has existed for a long time, especially if it has been frequently tapped, the walls of the cyst undergo calcareous degeneration, giving the impression of a hard tumor. This has repeatedly been mistaken for sarcoma or enchondroma, a mistake which is quite unfortunate, because it is usually not discovered until after the organ has been removed.

Technique in Children.

In children simple tapping will suffice to bring about a permanent cure. This may be repeated a few times if necessary, and if not permanently successful it should be followed by the injection into the sac, after the latter has been very carefully emptied, of a few drops of ninety-five per cent. carbolic acid. The cannula of the trocar should be closed and left in place while the carbolic acid is distributed over the entire surface by carefully massaging the scrotum. After a few minutes the cannula should be opened, and whatever fluid may have again accumulated, together with the carbolic acid, should be drawn off. In small children five drops of a thirty per cent. solution of carbolic acid in glycerine will suffice, if the sac has been carefully emptied before this fluid is injected. It does not matter if

all of this fluid remains in the sac, as the amount is not sufficient to cause symptoms of poisoning from absorption.

During the entire manipulation the external abdominal ring should be compressed, in order to prevent the introduction into the peritoneal cavity of any portion of the carbolic acid, in case the upper end of the tunica vaginalis has not yet become entirely closed.

In hydrocele of the cord in children tapping alone almost always suffices. If this is not the case, it is well to make a longitudinal incision, opening the hydrocele and tamponing the cavity with iodoform gauze. After a few days the gauze may be removed and the wound will heal completely in a short time. It does not matter that the inguinal canal is thus left wide open after the hydrocele of the cord which closed it has been emptied and can consequently no longer act as a plug. During the short period that the child will be compelled to remain in the recumbent position the canal will contract sufficiently to prevent the protrusion of a hernia.

Technique in Adults.

If the patient can conveniently abandon his work for one to two weeks, it is usually best to advise the operation for radical cure, to be described presently. If he cannot leave his work and desires only temporary relief, tapping will accomplish this. If he cannot remain away from his work, but still desires to obtain some hope of a permanent cure, without a certainty, it may be well to make use of the ninety-five per cent. carbolic acid, just mentioned, with a change in the quantity to be employed. After aspirating the fluid, from one to two drachms of ninety-five per cent. carbolic acid is injected and forced into contact with every portion of the lining of the sac by massage. The acid should be left in contact with the surface for at least five minutes, then it should be forced out through the cannula, which, of course, has in the meantime been kept closed. The patient should then be put to bed for a few hours, after which he may resume his occupation. In our own practice we have frequently applied this treatment on Saturday evening, and the patient has always been able to resume work with perfect comfort on Monday morning.

In about one-half of all the cases this method will result in a permanent cure, and it is worth while to explain to each patient coming for treatment the first time, that in about one-half the cases this simple method will accomplish everything he may desire. The method has the further advantage of being painless. Recently we have followed the plan practised by Coley of completely aspirating the fluid contained in the hydrocele and then injecting five drops of a ninety-five per cent. solution of carbolic acid, or fifteen drops of a thirty per cent. solution in glycerine, and leaving this in the sac. The proportion of cures seems to be about equal to that just described.

Radical Operation.

An incision, one and one-half inches in length, is made over the anterior surface of the side of the scrotum involved, directly down through the tunica vaginalis, which will permit the fluid to escape. The inner surface of the sac and the surface of the testicle are carefully inspected in order to detect any tubercles which might account for the accumulation of fluid. If present they are carefully removed, preferably with the knife of an electro-cautery. If none are found the tunica vaginalis is everted over the testicle and held by a few stitches of cat-gut; then the testicle, together

with its everted tunica vaginalis, is replaced in the scrotum. Great care is exercised to secure absolutely perfect hemostasis so as to prevent any accumulation of blood in the scrotum after the operation. The deep fascia is first sutured with cat-gut and then the skin is united. An ordinary dressing is applied and held in place by a suspensory bandage.

It is very important to inspect the testicle carefully in order to discover any small cysts which may be present on the surface, either because of the adhesion of a portion of the tunica vaginalis, or of accumulation of serum underneath the portion of this structure covering the testicle. In either event the anterior layer of tunica vaginalis is cut away entirely in order to exclude the possibility of a recurrence.

The wound heals in a few days, and in a week the patient is able to follow his usual labor. The operation is so simple, safe and satisfactory in its results that it seems foolish for one to carry a hydrocele about for years and go through the annoyance of repeated tapplings when he might in a few days obtain permanent and perfect relief.

CYSTOTOMY.

During the past few years it has become an almost universal practice to open the bladder through a suprapubic incision for the removal of stones and foreign growths, and for permanent drainage of the bladder from any cause. The operation in itself is relatively simple.

Preparatory Treatment.

Before undertaking any operation upon the bladder it is desirable that the urine should be as nearly aseptic as possible. Measures should be taken to make the urine as nearly normal as the conditions of the patient will permit. That affection for which the operation is required usually predisposes to an abnormal state of the urine, and frequently not only the bladder, but also the kidneys are diseased. If the urine contains septic material this may be changed by dilution, the patient being given large quantities of distilled water, or, if this is not agreeable, one of the various mineral waters in large quantities. Such course will reduce the septic character of the urine to a great extent. If the urethra is permeable to the passage of a catheter, irrigation of the bladder with a mild, non-irritating antiseptic solution, such as boric acid; 1:1,000 solution of permanganate of potash; 1:2,000 solution of nitrate of silver; a saturated solution of acetate of aluminum; or a solution of any one of a number of recently produced silver salts, may be used. These silver salts have the advantage of not being precipitated by contact with urine. These solutions may be used in from one to ten per cent. strength, and from one to two ounces may be safely left in the bladder after conclusion of the irrigation. If a solution of nitrate of silver is used the bladder should first be irrigated repeatedly with distilled or boiled water, as otherwise all of the silver will at once be made useless by being precipitated in the form of silver chloride. Adding an ounce of strong alcohol to a pint of saturated solution of boric acid makes one of the best solutions for irrigation.

Care should be taken not to irritate the bladder with any of these solutions. If it is found that one irritates more than the other it should be avoided. The bladder should be filled moderately full and then the fluid permitted to escape, or the bladder may be irrigated with a constant stream

through a double catheter, one tube serving the purpose of introducing the fluid, the other of emptying the bladder. A repeated examination of the urine will determine whether this treatment reduces the amount of septic material regularly found.

There are a number of antiseptics that may be given internally as urinary disinfectants. Of these five grain doses of boric acid given with half a pint of distilled water, or mineral water, every three hours; the same dose of salol, or of urotropin; or one-grain doses of methylene-blue given in the same manner, are probably the most useful. There is, however, this fact to remember, that urine usually is most septic if the bladder is not at any time completely evacuated, and consequently but a slight amount of benefit is to be expected unless the residual urine is removed once or twice, or oftener, each day, and the bladder carefully irrigated.

Just before the operation the bladder should again be carefully and repeatedly irrigated so that any accumulation of septic material may be thoroughly washed away, and any remnants that cannot be so washed away may be thoroughly diluted. In many cases the bladder contains weakened points and consequently great care should be used in this final irrigation, which is usually performed after the patient has been anesthetized, not to fill the bladder with too much force for fear of causing a rupture at some frail point. After this irrigation has been completed the bladder should be filled moderately either with air or water. The latter may be injected through a catheter by means of an ordinary bulb syringe, not more than eight ounces being introduced. The quantity can be measured by the size of the bulb used. In case air is used, it is best to leave the catheter in place after the bladder has been irrigated and to attach it by means of a glass tube to a rubber bulb. The incision is then made through all the tissues down to fat in the space of Retzius. Then the bladder is pumped full of air and it can be observed as it expands in the depths of the wound.

Many surgeons prefer to make a transverse incision, just above the pubic bone, down to the aponeurosis of the recti muscles, and then to cut longitudinally between these muscles. We have made this incision, as well as the longitudinal one about to be described, and have found both equally satisfactory.

The field of operation has, of course, been carefully shaved and prepared; then a longitudinal incision is made in the median line directly upwards from the os pubis, a distance of five centimeters. The muscles are separated and the fat above the pubis and front of the bladder exposed. This contains a number of veins of considerable size which usually extend transversely or obliquely across the incision. They should be grasped with hemostatic forceps on either side, cut and ligated at once. The wound is carried through the fat down to the wall of the bladder. In making this dissection great care should be taken not to extend the incision too high for fear of entering the peritoneal cavity. This is not likely to occur, however, if the bladder is filled with water or air unless the viscus is pendulous and displaced backwards. In such event the peritoneum may approach the os pubis and may have to be shoved upwards and held out of the path of operation by means of retractors. A suture is then applied to the wall of the bladder in the upper angle of the wound for the purpose of securing it against separation from the anterior abdominal wall. Two other stitches are applied in the bladder wall with curved needles one centimeter to each side of the median line. Forceps should be applied to each one of

these stitches, and the bladder wall drawn forward gently. A longitudinal incision is then made, from one to three centimeters in length, according to the object of the cystotomy, and the edges of the wound grasped with fine-toothed forceps and held open while the interior of the bladder is being exposed. As soon as this incision is made the fluid (or air) contained in the bladder will escape and the bladder walls begin to contract. If a stone is present its size may be determined and the incision in the bladder wall increased if necessary. The position of the stone is determined with the finger, and it is grasped by means of stone forceps in its narrowest diameter and withdrawn from the wound in the bladder with the gentlest possible motion. The interior of the bladder should then again be examined for further stones, and this should be repeated until all such have been removed. If a tumor is present an assistant should introduce two or three fingers into the rectum and force the tumor toward the wound so as to facilitate its examination and removal.

The method of removal of a tumor will depend largely upon its size and location, and must be determined upon general principles in each case.

If the operation has been undertaken for the purpose of securing permanent drainage, the incision should be made as near the os pubis as possible, and be only just large enough for the purpose of permitting careful digital exploration. Several purse-string sutures should then be applied to prevent leakage, and a retention catheter introduced. The wound should be tamponed around this retention catheter and the stitches in the bladder wall passed through the edge of the wound and tied just sufficiently tight to hold the anterior wall in close apposition with the abdominal wall. A few silkworm gut sutures are then applied, so as to grasp the wound on each side, and to take a small bite in the anterior wall of the bladder above the point of incision, and two small bites, one on each side of the incision in this portion of the bladder. These sutures are left untied until the first dressing, which occurs a few days after the operation, when the gauze tampon and the three first stitches may be removed and the silkworm sutures may be tied, leaving only a space open through which the drainage tube passes. If the bladder has been in a septic condition, it is often best to pass two ordinary rubber drainage tubes one-half a centimeter in diameter, perforated with several small openings in the end. It is then possible to irrigate the bladder by permitting the fluid to flow in through one of these tubes and out of the other; and in case one or the other becomes occluded with mucus or blood the free one will suffice to drain.

After-treatment.

The most important point in the after-treatment consists in giving the patient large quantities of pure water to drink. If the patient is at all shocked by the operation it is wise to give him a saline transfusion at once, or to give him an enema of half a pint of normal salt solution every hour.

It is well to give the patient from two to five drops of dilute aromatic sulphuric acid in half a pint of distilled water every hour during the day, and every two to three hours during the night. This will prevent the accumulation of earthy phosphates in the bladder or in the drainage tubes.

The bladder should be irrigated with a saturated solution of boric acid from two to six times a day, according to the character of the urine. If two rubber tubes are employed, sufficiently long for the ends to project into an antiseptic solution in a bottle tied to the side of the bed, the patient will

doing injury to the delicate structure of the canal. If the original sound passes to the prostatic urethra, then successive sounds are introduced until the largest one has been secured that can be freely passed.

If any one of the sounds used meets an obstruction it is withdrawn and the depth of the obstruction carefully noted; also the size of the largest sound which will just pass this obstruction.

Internal Urethrotomy.

The urethra is next examined by means of a bulbed sound, the bulb having approximately the shape of an olive. These sounds are introduced in successive sizes until one is reached which will just pass the constriction. It is then passed on and may possibly encounter further constrictions, which it may or may not pass. If a smaller constriction is encountered, smaller bulb sounds are used to determine the size of such obstruction. The locations of all constrictions are carefully noted as to their depth and size. After all these facts have been determined an Otis urethrotome is introduced into the urethra and the indicator turned to the point registering the size of the smallest stricture, the point of the urethrotome being inserted one-half inch beyond the location of this stricture as determined by the measurements. The concealed knife is directed either downwards or upwards, so that the cut will be precisely in the median line. It is then withdrawn a distance of an inch or a little more, when the knife is forced into its position of concealment. The urethrotome is then withdrawn and the urethra further measured for other strictures; if found they are treated in the manner just described.

After repeated examinations determine every portion of the urethra to be of normal size, as measured by the bulb sounds, and after this examination has indicated the urethra to be uniform in size, a large urethral sound, No. 30 to No. 40 French, according to the size of the patient, is introduced. If the bleeding is profuse a large catheter is passed and the cut surface is held against this catheter by means of rubber adhesive straps applied circularly over a padding of cotton at least one-half inch in thickness. In this manner hemorrhage can easily be controlled. The catheter is left in place for twenty-four to forty-eight hours, and the bladder irrigated through it with one of the various antiseptic solutions before mentioned, from one to six times each day, according to the character of the urine.

After-Care.

The same after-treatment which has been described for cystotomy, so far as the administration of large quantities of water and internal antiseptics are concerned, should be followed. After the fifth day steel urethral sounds, or hard rubber bougies are introduced, at first once every three or four days, then every second day, then every day, and when the urethra has been permanently dilated so that it will comfortably take the largest desirable sound the frequency of treatment may be reduced again; at first they are to be used every second, then every third, then every fourth day, etc., until presently they are introduced but once a month. This should be continued for many months until the surgeon has evidence that no further contraction will take place. It is to be remembered that a urethra which has once been strictured can be kept open with much less difficulty and with much greater comfort if a series of sounds is passed once a month, than if the stricture is permitted to reform and has to be gradually dilated.

In case it is impossible at the primary examination to pass a sound of any size through the stricture the patient should be placed in bed and the further treatment which has been mentioned should be prolonged. Patients should also be given hot baths, and after this treatment has been continued for some time it will be found that the stricture is not so tight as it was at the beginning of this attention. It will then usually be possible to introduce a filiform bougie. This should be attached to the end of a conical sound, and with this the stricture slightly distended. After this has been accomplished the conical sound is replaced with the urethrotome and the stricture cut as described before. Entire urethrotomy is, however, not safe in strictures located beyond the distal half of the membranous portion of the urethra, because the use of this method is likely to be followed by severe extravasation of blood and sometimes by extravasation of urine; the latter may result in sloughing of a great amount of tissue.

EXTERNAL URETHROTOMY.

In very tight strictures of the membranous portion of the urethra it is probably always best to do an external instead of internal urethrotomy. If the stricture is tight, however, internal urethrotomy should always precede the external, because with a filiform bougie attached to the conical sound, and later to the urethrotome, as has just been described, it is practically always possible to split the stricture smoothly and with the infliction of as little unnecessary traumatism as is possible to the urethra; moreover, after internal urethrotomy has been performed a grooved steel sound can be introduced into the urethra and then external urethrotomy done without great difficulty.

It is quite the opposite if an external urethrotomy is undertaken in a tight stricture instead of first performing an internal urethrotomy, because the exceedingly small opening in the strictured portion of the urethra can often be found only with the greatest amount of difficulty, if at all, and in the search for this opening a great amount of tissue is frequently destroyed. Had the internal urethrotomy been performed in the same case before the external operation was attempted, all such traumatism would be avoided. If, however, it is impossible to introduce a filiform bougie through the stricture, and consequently impossible to do an internal urethrotomy, an attempt may be made at finding the remaining opening through an external incision. Occasionally the surgeon may be more fortunate in his search than he could reasonably expect, and in this way may discover the remnant of the original canal. If this fails, however, after a reasonable attempt, it is best to perform a suprapubic cystotomy and introduce a sound into the urethra from the side of the bladder, and carry this down into the wound of the urethra to the point of the stricture, and then cut down externally upon the point of this sound. With this guide it will then be possible to slit open the stricture. Preferably a fine probe is used, which is introduced from the upper portion of the stricture downward, the latter being at the end of the sound which has just been introduced from the bladder.

After-treatment.

The wound is then open and dressed with ordinary antiseptic dressings. The remnant of the mucous lining of the urethra will begin to pro-

liferate and form a covering of mucous membrane over the adjoining portion of the wound. Presently it will show a tendency to close in upon itself and reproduce the original canal. In the meantime care should be taken not to permit the distal end of the urethra becoming again contracted. This may be prevented by the introduction of steel sounds once every two or three days. After the urethra shows a tendency to close a catheter should be introduced into the bladder through the entire length of the urethra and the wound permitted to heal around this catheter. The same precautions for the dilution of urine which have been described after suprapubic cystotomy should be employed in these cases. Occasionally an external urethrotomy is indicated by the presence in the urethra of a fistula, showing the existence of the stricture to the distal side of the fistula. The operation in such case is the same as that which has just been described.

RUPTURE OF THE URETHRA.

The most urgent demand for an external urethrotomy is a severe traumatism of the urethra. This is usually caused by falling astride some hard substance, such as a beam or board in buildings being constructed, or falling astride a wagon wheel by teamsters, or falling upon the pommel of the saddle by horsemen, or any other similar accident. The patient suffers severe pain in the region of the perineum; there is usually a flow of a variable amount of blood from the urethra; there is an obstruction to the flow of urine, and upon introducing a catheter into the urethra it brings blood, but no urine. If the injury is recent these may be all the symptoms determined. If it has existed for a longer time there is severe ecchymosis, there may be marked edema, and there frequently is an area of necrosis, which varies with the severity of the injury and length of time that has elapsed since its occurrence.

If the catheter passes the obstruction and enters the bladder, this will be indicated by a flow of urine. In such event, it is wise to irrigate the bladder with some antiseptic substance and to leave the catheter in place, for fear of, not being able to reintroduce it, for the purpose of preventing extravasation of urine by the perfect draining of the bladder, and also for the purpose of acting as a splint in directing the process of healing in the ruptured urethra. If the surgeon is not fortunate enough to introduce the catheter into the bladder without the use of force, he should abandon the attempt without having increased the existing traumatism, the only rational means then of treating these cases being with an external incision.

Technique.

The patient is placed in the lithotomy position; the skin prepared for operation; a longitudinal wound made upon the end of the urethral sound which has been introduced to the point of obstruction. This sound will indicate the location of the distal end of the urethra. If it is difficult to locate the proximal end of the urethra this can usually be effected by making gradual pressure upon the bladder, thus forcing out some of the urine, which will indicate the proximal end of the canal. The incision is then prolonged until it passes the proximal end of the urethra for about an inch. The two extremities of the urethra are then united by means of fine catgut sutures for about two-thirds of their circumference, the most superficial third being left for drainage. A catheter is then introduced

through the entire urethra into the bladder, and the remaining portion of the wound permitted to heal by granulation.

It has been our experience that a complete union of the urethra in these cases can be accomplished much more rapidly and perfectly if the entire circumference of the urethra is not sutured at once at the time of the first operation.

After-treatment.

The after-treatment is the same as before mentioned. The retention catheter is left in place until the wound in the urethra has apparently completely healed. If the patient does not come under the surgeon's care until a considerable portion of the urethra has become necrotic, it may be necessary to excise this and bring together portions of the urethra a considerable distance from each other. This, however, can be done with safety and with comfort to the patient.

RESECTION OF THE STRICTURED URETHRA.

The same conditions may be established if a portion of the urethra has been entirely destroyed by inflammatory processes, leaving a cicatricial stricture, in which a recovery of the lumen of the urethra is impossible. In such case the cicatricial stricture is entirely excised and the urethra above and below united by means of fine catgut sutures, the most superficial third of the circumference of the urethra being again left open. A retention catheter is introduced and the wound dressed in the usual way.

Prognosis.

The prognosis in all of these cases treated for a long period of time after they have apparently completely recovered is relatively very good, provided no further gonorrheal urethritis occurs. It is, however, to be remembered that these patients should return to the surgeon from time to time, so that he may determine the tendency to recurrence of stricture at a period when the condition can be most easily relieved, and if any such tendency exists, it should be overcome by the careful use of sounds before it has reached an advanced stage.

VASECTOMY.

The excision of the vas deferens may become necessary on account of tuberculosis of this organ, which is not uncommon, or on account of a malignant growth (sarcoma extending to the vas deferens from the testicle being the most common cause), or the operation may be performed with a hope of causing a reduction in the size of an hypertrophied prostate gland. It is likely that this operation will be employed for the purpose of securing sterility in patients either physically, mentally or morally impaired to such an extent as to make their progeny dangerous to the community at large.

Technique.

The extent of the procedure will depend upon the condition for which it is to be performed. If a considerable portion of the vas deferens is diseased the incision should extend from the external abdominal ring down to the lower portion of the scrotum. The tissues of the cord being exposed, the vas deferens will be recognized as a hard, round cord. This, in case of malignancy, will be removed, together with all the tissues of the cord and

the testicle. In case it is tubercular and the disease has not penetrated the organ and infected the surrounding tissues, it is separated from the adjacent parts to a point two centimeters or more beyond the affected portion. It is then ligated with catgut at each end and excised.

If the entire vas deferens is tubercular it should be carefully dissected as far up in the inguinal canal as is possible without fear of breaking it off. A syringe with a blunt-pointed needle is then filled with ninety-five per cent. carbolic acid. The needle is introduced into the vas deferens and the carbolic acid injected very slowly into its lumen. After the acid has been in contact for five minutes the syringe is filled repeatedly with strong alcohol, which is also injected through the lumen of the vas deferens in order to prevent the carbolic acid from causing too much destruction.

Should the operation be intended only for the interruption of the continuity of the canal, a small incision two centimeters in length is made opposite the external abdominal ring, the tissues of the cord are brought into the incision, the vas deferens is separated from the other structures of the cord, two catgut ligatures are applied a centimeter apart, and the intervening portion excised. The tissues of the cord are then replaced and the wound in the skin closed with one stitch.

Regarding the effect of this operation for the relief of hypertrophy of the prostate gland, we would say that there are undoubtedly certain patients who are permanently benefited by this form of treatment. It is, however, impossible to determine beforehand which patients will be so improved, and consequently it is impossible to make a reliable prognosis. The operation in itself is simple; it can easily be performed under cocaine anesthesia; it is not accompanied by pain; and results in no deformity. All of these reasons make it one which should not be condemned, although the relative number of permanent recoveries is not sufficient to warrant its general adoption.

PROSTATECTOMY.

This operation has grown greatly in favor during the past few years, principally because attention has been paid to its careful technical development. It is performed entirely for the removal of hypertrophied prostate glands. We will only describe the perineal method, because the suprapubic method virtually corresponds to the operation for suprapubic cystotomy, to which is added the enucleation of one or more lobes of the enlarged prostate gland projecting into the bladder. For all cases of prostatic enlargement in which there is not a distinct projecting lobe into the bladder, we would perform the perineal operation.

In the consideration of this operation it must be remembered that patients upon whom it is performed are usually advanced in years, because hypertrophy of the prostate gland occurs most frequently at such time. There has been an obstruction to the passage of urine, which has usually resulted in the accumulation of residual urine in the bladder, predisposing to infection and consequent cystitis. Many of these patients have infected their bladders mechanically by the use of septic catheters, in many these conditions have resulted in the formation of stone; in many, again, the infection has advanced by one or both ureters into the pelvis of the kidney, giving rise to a pyelitis; and still again many are found suffering from a chronic nephritis, which is not uncommon in patients advanced in years, though there may be no direct mechanical cause for its occurrence. All



PLATE CXXXIII

PROSTATECTOMY

A horseshoe shaped incision is shown with the two branches opposite the tubercle. The flap is drawn backward by a vaginal speculum (d) the wound is held open laterally by the retractors (ee) the urethra is seen deep in the wound anteriorly at (c) the prostate gland (b) is drawn downward by means of the cat's paw retractor (a)

these facts would indicate that this operation, as a rule, is done on a class of patients who are not well fitted to endure any serious surgical undertaking, which must of course be borne in mind when this operation is suggested. The facts which are in favor of this operation in those whose general condition is not good are:

1. That the patient will be relieved of pain.
2. The drainage of the bladder which follows the operation relieves the urinary obstruction and at the same time prevents further septic absorption from residual urine.
3. The bladder is accessible to irrigation after this operation, so that any septic material which may be secreted from its walls can be frequently washed away.
4. The patient is not exposed to the likelihood of infection in the future, which is almost inevitable if he is compelled to resort to the daily use of a catheter for the purpose of evacuating the bladder.

It remains now to reduce to the minimum the amount of traumatism required for the removal of the enlarged prostate gland. We believe that the operation herewith described fills this requirement.

Preparation for Operation.

It is important that patients about to undergo this operation should be carefully prepared in the manner described in connection with suprapubic cystotomy. These cases are almost all chronic in character when they reach the hands of the surgeon; consequently a few weeks spent in securing as aseptic a condition of their bladders as possible is not of much importance to them. It is not so much of a hardship to a man to postpone his relief for a few weeks, after he has suffered for a long time, as it would be if his suffering were acute, and we believe that success depends to a very large extent upon the careful preparatory treatment.

Technique.

Before beginning the operation, the bladder is carefully irrigated with one of the mild antiseptic fluids mentioned before in connection with bladder surgery, until the fluid returns perfectly clear. The bladder is then completely emptied by placing a soft rubber catheter so that it will act as a siphon, and by making pressure upon the bladder above the pubis. The soft rubber catheter is then removed and a steel sound introduced to the prostatic portion, but not through it, to act as a guide in locating the urethra. A horseshoe-shaped incision is then made from a point opposite the tuberosity of the ischium on one side to that on the other, the convex portion extending across the perineum, as indicated in Plate CXXXIII. With a finger in the rectum and the steel sound in the urethra one can readily and safely make the dissection forward until the entire lower surface of the prostate gland is exposed, as shown in this plate. A few insignificant vessels will be encountered, and from each side there will be one or more divisions of the internal pubic artery which will bleed freely, but it can be grasped, either before or after division, with hemostatic forceps and ligated at once in order to leave the space entirely free. All of the smaller vessels may be grasped and also ligated, the important point in this portion of the operation being the complete, careful exposure of the prostate gland. A sharp-toothed cat's-paw retractor is then caught in one lobe of the gland and the latter drawn downward. With a sharp scalpel the capsule of the other lobe is then incised deeply, care being taken not to approach the

middle portion of the gland. A second retractor of the same kind is then inserted into the lobe which has just been incised, and the gland kept drawn down while a second deep incision is made through the capsule of the second lobe. While the gland is still held downwards by means of the cat's-paw retractor, a finger is introduced into the incision which has just been made and one lobe of the gland freed from its capsule, regard being taken not to approach the median portion. The retractor is then again changed to the other lobe, and the second lobe is enucleated with the finger, care being again taken not to approach the middle portion until the lobe has been entirely freed. In this manner a considerable amount of annoying hemorrhage is avoided, which comes from the submucous veins at the neck of the bladder. In case the middle lobe is approached at first, these veins are likely to cause a sufficient amount of bleeding to cloud the field of operation.

One finger is now introduced behind each lobe, and by bringing the two fingers together posteriorly, the entire gland can usually be rolled out forward. The anterior attachment is then cut away with scissors, in order not to disturb the anterior portion of the prostatic urethra unnecessarily. A gauze pad is inserted at once to make a slight amount of pressure, which will cause the bleeding to subside readily.

A finger is then introduced into the bladder in order to determine the presence of one or more stones. Occasionally, after a thorough examination of the bladder with a steel sound has failed to determine stones, the digital examination after the removal of the prostate gland will still demonstrate their presence. If stones are found the surgeon should determine whether the opening in the bladder is sufficiently large to permit their extraction. If not then an incision is made posteriorly until the desired size has been obtained. The stones are then removed in the ordinary manner. In ordinary cases all that remains to be done is the introduction of a rubber tube, with numerous small perforations near the end, to the fundus of the bladder. This should be stitched into the angle of the wound. A piece of iodoform gauze may then be tamponed against the remaining portion of the capsule of the prostate gland and permitted to protrude from the wound of the perineum near the point at which the drainage tube issues. A few stitches are then applied to replace the flap.

We believe that it is best not to suture the flap too tightly, because there will be considerable oozing, and if there is a sufficient amount of space for drainage to take place the patient will be saved the possibility of the accumulation of wound secretion. If the bladder has been severely infected we believe it is better to introduce two drainage tubes a little smaller in size to the fundus of the bladder so that irrigation may be accomplished by injecting the irrigating fluid through one tube and permitting it to escape through the other after the operation. In case there should be considerable hemorrhage from the capsule—which, however, is not common—this may be controlled by the application of a few hemostatic forceps, which are permitted to protrude through the wound, and which may be removed after twelve or twenty-four hours with safety. If there is much oozing the space may be tamponed with sufficient iodoform gauze to overcome it, but it does not frequently happen that the tissues require this form of tamponing.

After-treatment.

The bladder should be irrigated with one of the various mild anti-septic fluids from one to six times a day, according to the condition of the viscus wall. The iodoform gauze is withdrawn after the second or third

day, and from the fifth to the tenth day the rubber drainage tube is removed. In many cases the patient has no difficulty after this time with evacuating the bladder normally, but if the flow of urine is not normal it is wise to introduce a soft rubber catheter through the urethra into the bladder for a few days. It is well to remove it every second or third day to see whether the normal conditions have been established, and if they have not, the catheter may be replaced. During this period it is well to give some mild antiseptic internally and to give the patient large quantities of pure water, in order to dilute the urine. It is well to encourage him to sit up the second or third day after the operation, and to get out of bed as soon as possible, because men at this age do not bear confinement very well.

Prognosis.

Bearing in mind the condition of these patients, aside from that of the prostate gland, they withstand this operation remarkably well, and the difference in the comfort of the patient and the improvement in his general condition is very marked. In many cases the free drainage seems to improve the function of the kidneys decidedly, so that after a few months a marked albuminuria may almost entirely disappear. The fact that a constant source of septic infection has been removed is of very great importance to the general health of the patient. We believe this operation will add many years to the lives of these sufferers.

Complications.

Occasionally it will be found that the existing adhesions prevent the enucleation of any considerable portion of the prostate gland, and that in order to remove it in the manner just described it will be necessary to produce too severe a traumatism; consequently if it is found impossible to enucleate the lobes of the prostate as described, the following method should be substituted:

The operation is performed as described above to the point of enucleation. This is attempted, but if it proves unsuccessful, the sharp-toothed cat's-paw retractor is applied to one lobe, as indicated in Plate CXXXIII, and the substance of the gland removed piecemeal with cutting forceps. The extent to which it has to be removed can easily be determined by inserting the finger into the field of operation from time to time. The operation is more tedious than enucleation, but much safer than in cases in which enucleation cannot be readily accomplished. The drainage of the bladder and the after-treatment are the same as described before.

Until one has become thoroughly familiar with the perineal removal of the prostate gland it is probably best to follow the above method, because the entire operation is performed virtually in plain view of the operator, which is, however, quite unnecessary after one has acquired a clear comprehension of the conditions.

The following operation is much less difficult; is combined with much less trauma; it can be performed in one-fourth the time required, which is an important element; and the results are proportionately more satisfactory. The operation combines all of the advantages of the suprapubic prostatectomy with perineal drainage and does not contain any of the many disadvantages of the suprapubic route.

Technique.

A grooved sound is introduced into the urethra, then an incision is

made from a point half way between the scrotum and the anus to one half way between the anus and the tuber ischii. This incision is carried into the membranous urethra.

Then an old fashioned lithotomy knife with a knob end is placed in the groove of the sound and the sound, together with the knife, is carried into the bladder, splitting open the membranous and the prostatic urethra throughout their course posteriorly. The finger is then introduced into the bladder and the two lobes of the gland are enucleated precisely as one would do this in suprapubic prostatectomy. A drainage tube is introduced and the space from which the gland has been removed is tamponed with gauze. If there is troublesome hemorrhage the bladder is pulled down with the finger and hemostatic forceps are applied to the edge of the capsule and these are left in place for twelve hours, when they are loosened. They are not withdrawn until the following day. It is but rarely necessary to apply these forceps.

In cases in which the gland cannot be enucleated it may be gnawed away with the Ferguson punch-forceps.

The entire operation can be completed leisurely in fifteen minutes, while a rapid operator can accomplish it in one-fourth of this time with safety

PROSTATOTOMY.

This operation is performed for the relief of abscess of the prostate gland. In young individuals with an infection of the gland, due to specific urethritis, it is often found that the gland is filled with multiple abscesses, which will keep the patient in a slightly septic condition for a long time. This infection may progress to form larger abscesses, but these usually have for their exciting cause the introduction of steel sounds or bougies. The abscess may increase in size to such an extent as to produce a swelling in the region of the perineum, or it may produce a fluctuating tumor in the rectum. This is accompanied by severe pains and symptoms of acute suppuration. A large abscess that causes swelling in the region of the perineum should be opened through a perineal section, being careful not to injure either the rectum or the urethra. It is well to make the incision quite into the prostate gland, to curette away the infectious material, and tampon the cavity with iodoform gauze. If the fluctuation can be discovered by digital examination through the rectum, the incision just described may be used, or the swelling in the rectum may be exposed by the use of retractors and the abscess opened into the rectum by the use of the actual cautery. In this event, the opening should be made large enough to insure permanent drainage. The opening will increase in size if it has been made by the cautery, because the eschar which is formed throughout the circumference of the opening will fall off as healing progresses, and thus increase this aperture.

Much has been said against the opening of prostatic abscesses into the rectum for fear of infection. If the wound has been made as just described, and if the patient has received proper preliminary treatment, consisting in the administration of two ounces of castor oil for two successive days previous to the operation, with thorough repeated flushings of the bowel before the operation, and if the operation is followed by proper after-treatment, consisting in the administration of a saline laxative daily and thorough flushing after the evacuation of the bowels, then, according to our ex-

perience, the results will be perfectly satisfactory. It is quite different if the abscess is simply incised, especially if the preliminary and after-treatment are not carried out with care.

In the presence of multiple small abscesses of the prostate gland, resulting from repeated infections from gonorrheal urethritis, the gland is exposed as in the operation described for perineal prostatectomy. Then it is drawn down, as indicated in Plate CXXXIII, and a deep incision made transversely across each lobe of the prostate, and this is carefully tamponed with iodoform gauze. A small rubber drainage tube is introduced to each lobe of the gland, but not into it, and the wound closed with sutures, with the exception of the two lower angles through which the rubber drainage tube and the iodoform gauze issue.

Prognosis.

This operation may result in the complete relief of the patient, especially if he has not the misfortune of acquiring a further gonorrheal urethritis. In many cases, however, the recovery is not permanent, and it will be necessary to perform a prostatectomy in order to give permanent relief.

EPIDIDYMECTOMY.

In a majority of cases of tuberculosis of the testicles they are involved secondarily, the primary tuberculosis being in the epididymis, and in many cases in which the testicle is supposed to be tuberculous a careful examination will reveal the fact that the disease is still confined to the epididymis. If this is the case, it is, of course, not necessary to disturb the testicle during the operation, which should simply consist in making a wedge-shaped excision of the epididymis, together with the vas deferens, which is usually involved, and to close the defect with fine catgut sutures. Even if there is a moderate infection of the testicle, a conical excision of the diseased area may be made when the epididymis is removed, and the defect closed with buried catgut sutures. It is only in case of multiple tubercular foci in the testicle, in which it seems impossible to preserve any portion of the organ, in which the multiple puncture with the actual cautery is indicated, because with this method it is possible to preserve a remnant of the organ, even if apparently the entire gland has been destroyed by the tuberculosis.

It is plain that a wound made in this manner cannot heal so quickly as a clean cut one, but the patient is very willing to undergo the necessary annoyance in order to secure the resulting benefit.

The cicatricial tissue which develops as a result of the cauterization seems to do much to prevent the further destruction of the organ by tuberculosis.

If the vas deferens is involved in the tuberculous process it should be excised. It is not difficult to follow this structure to a point near the bladder by slowly drawing it up into the wound and freeing it from the surrounding tissues by pressure with a moist gauze pad. The external incision may be carried to a point just outside the external abdominal ring. The diseased portion of the vas deferens is somewhat uneven and nodular. It is well to remove the structure to a point some distance beyond the portion that is diseased. In order not to have the vas severed too near the diseased portion it is well to make the dissection very slowly, and then place

a pair of hemostatic forceps at the point where it is desired to sever the structure, to apply a ligature at this point and then cut just proximally to the ligature. If the seminal vesicles are left in place and also the testicles the patient's sexual life will not be disturbed in the least by this operation, even if both vasa deferencia are removed.

This fact is important in connection with this operation when performed for the purpose of securing sterility of the male for sociological reasons.

It has been suggested to perform vasectomy for the sterilization of habitual criminals, epileptics, idiots and other degenerates for the protection of the community.

In this operation it is not necessary to make so extensive an operation. The skin over the vas deferens may be anesthetized by the injection of a one per cent. solution of cocaine, injected also about the vas, which is brought out through an incision two cm. long; it is ligated twice at a distance of one cm. apart and then severed. The wound is closed with one or two fine catgut sutures and the operation repeated on the opposite side.

The operation is justified by the fact that the community gains enormously while the individual loses nothing. He is not exposed to any risk, suffers no pain and is not inconvenienced in any other way except that parentage is prevented, which in these classes is never of any harm to the individual.

UNITING OF VAS DEFERENS ACCIDENTALLY SEVERED.

In case a vas deferens is accidentally severed during the progress of any operation it may be united by passing two sutures of fine double chromic catgut from without into the lumen of one segment, then into the lumen of the other segment, then out through its wall and tying loosely one on each side, and then applying a few fine sutures to the edges of the vas.

The catgut in the lumen acts as a splint and secures a continuous passage through the vas.

ABSCESS OF SEMINAL VESICLES.

In many cases the infection is limited to the seminal vesicles. This may be unilateral, or it may affect both sides. If the infection has become chronic nothing short of surgical treatment will give permanent relief.

Technique.

The same operation must be performed that has just been described as prostatotomy, differing in that the infected vesicle is located with the finger in the rectum, and that it is carefully and thoroughly removed with a moderately sharp curette. The space is then drained as in prostatotomy.

CASTRATION.

This operation is indicated for the relief of malignant disease of the testicle, for gangrene, or for traumatism, which would inevitably result in gangrene of the organ, for destructive suppuration, and for very extensive unilateral tuberculosis.

If tuberculosis occurs in both organs simultaneously, or in the remaining organ after the other has been removed for any reason, we have never

found it necessary to perform this operation, but have substituted the destruction of the diseased portion by means of the actual cautery. Even in cases in which only a very slight amount of the tissue may be preserved we have found this of great value to the patient. This is true even in cases in which it was necessary to remove the epididymis, together with the vas deferens. So long as it was possible to preserve the seminal vesicles there has been no mental depression in these cases on account of the partial destruction of the testes with the actual cautery, together with the removal of the vas deferens on both sides. It is quite different in case of double castration in patients too young to have passed beyond the virile period normally. Double castration, in our experience, has resulted in permanent relief from urinary obstruction due to hypertrophy of the prostate gland in about fifty per cent. of all cases in which we have made use of this method. There is, however, no definite guide that will indicate which cases are likely to be benefited. Moreover, the operation results in a deformity which is very repulsive to many patients, even though past the virile stage.

It seems as though this method should receive definite recognition, but since perineal prostatectomy has been so much simplified, and its safety so greatly enhanced, it appears doubtful whether castration for the relief of prostatic hypertrophy will continue to be employed to any great extent.

TUMORS OF THE TESTICLE.

The most common forms of tumor of the testicle are sarcoma, enchondroma and teratoma. All other forms may occur, but are not common. Tumors should be differentiated from gumma, inflammatory swelling, hydrocele with an unusually tense sac, or a sac which has undergone calcareous degeneration, scrotal hernia with incarcerated omentum, tuberculosis of the testicle and epididymis and simple hyperplasia of the testicle.

The most common error occurs in connection with gumma of the testicle, which is not a very unusual condition. It is frequently necessary to place the patient under vigorous antisyphilitic treatment for a few weeks in order to positively clear up the diagnosis. It seems wise in all of these cases to test the patient carefully with Ehrlich's remedy 606 before making a positive diagnosis of a malignant growth, as this remedy acts so promptly that even if malignancy is present the patient will lose little because of the delay. Tuberculosis can usually be eliminated more easily because of the nodular condition of the swelling and the tendency to breaking down of portions. There is usually also a tubercular history, and the progress of the disease is relatively slow.

The differentiation between hernia and hydrocele has been discussed in connection with these subjects.

Technique.

An incision is made through the skin from the external abdominal ring downward to a point near the lower edge of the scrotum; then the entire organ, together with the tunica vaginalis, is enucleated. A pair of heavy clamp forceps is applied just outside of the external abdominal ring, then the tissues of the cord are dissected out in the inguinal canal. If the tumor is quite advanced, the incision in the skin may be carried to a point opposite the internal abdominal ring, and may be carried through the deep fascia and the fascia of the external oblique abdominal muscle, exposing

the tissues of the cord throughout the entire distance of the inguinal canal. In this case the tissues of the cord are dissected out to this point.

The vas deferens is then separated from the remaining tissues of the cord, ligated with catgut, cut and permitted to retract within the internal abdominal ring. The remaining structures of the cord are then separated and the various larger vessels ligated and cut separately and successively permitted to retract beyond the internal abdominal ring. Then the remaining portion of the cord is ligated en masse and cut. In this manner one may easily guard against secondary hemorrhage. All bleeding points are carefully caught and ligated. A small drain is inserted in the lower angle of the wound in order to prevent the accumulation of serum from the large surface. The wound is then sutured and an ordinary dressing applied and held in place, preferably by a properly constructed suspensory bandage.

If the malignant growth has invaded the skin, or the other side of the scrotum, the same should be entirely removed, provided it seems likely that the disease is still localized. Unfortunately metastases usually occur in these cases before they have advanced to the point of invading the surrounding tissues; hence the prognosis is usually hopeless when this condition is present.

If the operation is performed without unnecessary traumatism, it is usually not followed by any severe degree of shock. In patients advanced in age, however, the shock is sometimes quite considerable, and many surgeons have reported the occurrence of acute melancholia, which, it seemed, was not due to sepsis in some.

In young patients this operation very frequently gives rise to mental depression, and should not be employed if there is any possibility of avoiding it.

In some cases the deformity may be corrected by inserting into the scrotum a properly shaped mass of paraffin or a hollow structure composed of celluloid of the same form.

One of these devices seems to be of considerable value to neurotic subjects, and if a patient seems inclined to be neurotic it may be well to make use of this plan at the time of the original operation.

PART IX.

SURGERY OF THE FEMALE PELVIS.

OVARIAN TUMORS.

The early history in cases of ovarian tumors is usually negative, the growth being discovered by accident. Among educated people in the higher classes of society such a tumor is usually discovered during a careful physical examination made by the family physician in the course of some illness of the patient which has no relation to the presence of the tumor. Thorough physical examinations are now so commonly made that in this class of patients the growth is usually discovered before it has advanced to any great size.

It is quite different among patients belonging to the so-called lower classes of society. Among these ovarian tumors are usually not discovered until they have attained considerable size, when the patient discovers the growth herself. In a large majority a history of peritonitis at some time in the past can be established, provided the conditions are favorable for obtaining a perfect history. In many cases the time of such peritonitis is so remote that it becomes necessary to inquire from the parents regarding the patient's sickness during childhood.

The peritonitis of early youth and childhood is usually due to appendicitis or typhoid fever, and occasionally to scarlet fever. Later on in life it is more commonly dependent upon a specific infection through the uterus and tubes, and still later to puerperal infection following childbirth or abortion.

These infections are certain to leave the ovaries covered with connective tissue which would favor the formation of retention cysts in the Graafian follicles.

Varieties of Cysts.

They may be simply retention cysts formed by the distension of Graafian follicles with serum secreted from the lining of these follicles. These may be simple or multiple, and may remain small or they may attain enormous size. The largest one we have encountered weighed eighty-one pounds in a woman weighing seventy pounds after the tumor had been removed. Cysts of this variety have, however, been reported weighing much more.

Again the epithelial lining of the Graafian follicle may take upon itself an abnormal development, forming a papilloma or a carcinoma. In this event the cyst contains gelatinous, viscid fluid. The papillomatous or carcinomatous growths may perforate the cyst wall and may infect the peritoneum covering the intestines, or the parietal peritoneum, and then the free peritoneal cavity may contain serous or gelatinous fluid. It frequently happens

that this growth invades the surrounding organs and gives rise to complications which are always serious in character ultimately.

Occasionally a portion of the ovary is located in the broad ligament and may in such location give rise to the formation of a cyst known as a cyst of the broad ligament, or intra-ligamentous cyst.

A tumor may consist of a simple retention cyst in one part, and a papillomatous cyst in the remaining portion.

It seems likely that many of these tumors which are primarily simple cysts, later on degenerate into papillomatous cysts, and these in turn into carcinomatous tumors.

Diagnosis.

Small ovarian cysts are diagnosed by bimanual examination. They are recognized as more or less spherical masses located in the pelvis. They may lie to the right or left, behind or in front, or above, the uterus. Unless there has been a recent pelvic peritonitis they are likely to be movable and can be separated from the uterus. If the abdominal walls are not very thick fluctuation can usually be recognized. Later on when the tumor has attained considerable size it rises in the pelvis and ultimately is forced by its size to occupy the abdominal cavity above the pelvis. Fluctuation can now usually be established across the abdomen. The tumor displaces the intestines, consequently percussion over its most prominent portion gives rise to a dull sound. Above and to either side there is resonance because of the location of the stomach and transverse colon. A change in the position of the patient makes no change in the percussion sounds. It is movable unless strongly adherent on account of peritonitis.

Differential Diagnosis.

Early in the disease it is most easily confounded with pediculated fibroid tumors of the uterus. The latter are, however, harder, more closely connected with the uterus, and there is with these usually a history of menorrhagia.

Extra-uterine pregnancy may be mistaken for ovarian cyst early in its development, but the absence of menstruation is likely to clear up such a diagnosis.

Pyosalpinx occasionally simulates an adherent ovarian cyst, but its location and the indications of a more or less septic condition usually suffice to determine.

Later on abdominal ascites may be mistaken for an ovarian cyst. An examination of the urine and the heart will establish a nephritic or cardiac cause for the ascites. In the physical examination it will be found that the area of dullness varies with the position of the patient in abdominal ascites, unless this is due to tuberculosis with the presence of adhesions. In ascites the tympany is usually over the most prominent portion of the abdomen while in ovarian cyst the opposite condition obtains, there being an area of dullness over the most prominent portion and tympany over the epigastric and lumbar regions, and a change in position does not greatly change the percussion sounds.

It frequently occurs that the intra-abdominal organs are completely fixed by the presence of adhesions due to tubercular peritonitis, and that the intestines and omentum form a wall above, and the pelvic organs together with the sigmoid flexure of the colon make a dam below, the free ascitic fluid, causing the latter to become encapsulated, as it were, between

the abdominal wall in front and these two barriers above and below. In such cases the percussion sounds are quite as constant as in the presence of an ovarian cyst, making the differential diagnosis from the physical examination virtually impossible. The history in such cases will show that the intra-abdominal accumulation was diffuse during the early part of the disease, but this is not always observed, because the surgeon is not consulted until later. There is also an evening temperature during some part of the attack, but this again is not always observed, and when the patient comes under the observation of the surgeon the temperature is no longer abnormal.

Obesity.

Every year we have a number of patients sent with a rather acute, circumscribed obesity or lipomatosis of the lower portion of the anterior abdominal wall, with the request to remove an abdominal tumor. Usually a diagnosis of ovarian cyst has been made on account of the presence of pseudo-fluctuation in this mass. The patients are usually obese, but the general condition thereof is slight compared with the local, and unless one's attention has been directly called to this a mistaken diagnosis is most natural. This can be avoided by grasping the mass laterally and lifting it, which will show it to be entirely in the tissues of the abdominal wall and not within the abdominal cavity.

Hydronephrosis.

A hydronephrosis is not uncommonly associated with movable kidney, and this mobility may be so excessive as to permit the kidney to visit almost every portion of the abdominal cavity, and, in fact, it may be so movable that it can be palpated in the pelvis, in which event it may be mistaken for an ovarian cyst. This condition is, however, uncommon. It usually begins in the region of the right kidney; there is irregularity in the size of the tumor, and the decrease in its size is associated with the free evacuation of urine. The tumor can be replaced in the right hypochondriac region, and when thus replaced the alteration just spoken of is liable to occur, because this disposes of the acute flexion of the ureter. There are, however, some cases in which it will, undoubtedly, be impossible to make a positive differential diagnosis.

Other Simulating Conditions.

A movable spleen, or liver, has occasionally been mistaken for an ovarian cyst. This is also true of cysts of the pancreas. Very rarely a greatly distended gall bladder may be exceedingly movable, in fact, quite as movable as a hydronephrosis, and in such an instance it may be mistaken for an ovarian cyst.

These errors in diagnosis are much more common in patients with thick abdominal walls. The fluctuation which is due to the fat in the abdominal wall frequently causes an error of diagnosis by transmitting the sensation of fluctuation to solid masses, such as the liver or the spleen.

Occasionally an ovarian cyst has a pedicle sufficiently long to permit the tumor to be carried to any part of the abdominal cavity, and then it is likely to be mistaken for a tumor connected with some organ in whose vicinity it happens to be first discovered. In one instance we encountered a carcinoma of the pylorus as large as a fist, which could be moved to every portion of the abdominal cavity and which was first discovered in the right inguinal region, and was mistaken for a cyst of the ovary.

These errors are, of course, quite uncommon, but it is well to bear in mind the possibility of their occurrence.

Ovarian Cyst with Twisted Pedicle.

At times an ovarian cyst with a long pedicle may develop to a considerable size without being noticed, until by some chance the pedicle becomes twisted upon itself and the nutrition of the cyst thus suddenly interrupted. If the blood vessels are entirely occluded the occurrence is likely to be accompanied by severe pain, which may give rise to a diagnosis of appendicitis, rupture of extra-uterine pregnancy, gall stones, or renal calculus passing through the ureter. The abdominal walls are usually so tense after such happening that it is practically impossible to make a positive diagnosis without the use of general anesthesia, unless the cyst is of appreciable size and the abdominal walls thin. The presence of a tumor will, of course, clear up the differential diagnosis, with the exception of extra-uterine pregnancy, which, however, is characterized by the presence of increasing anemia, and within a few hours after the beginning of the attack it is usually possible to palpate the coagulated blood in the cul-de-sac of Douglas by making a vaginal examination. This coagulated blood has a peculiar, doughy feeling, which, when once detected, will be readily remembered.

Distended Urinary Bladder.

One other condition has been mistaken for an ovarian cyst more frequently perhaps than any other, but this is usually the result of carelessness and is practically always cleared up before an attempt is made to remove the cyst by means of an operation, because it is now the universal practice to catheterize the urinary bladder before undertaking an abdominal section. It has frequently happened that a distended urinary bladder has been regarded as an ovarian cyst, but the passage of the catheter invariably clears up this diagnosis; and a surgeon who has once experienced this blunder will recognize it in future cases without the slightest difficulty.

Impacted feces in the cecum or in the sigmoid flexure have been misjudged for ovarian cyst. The free catharsis which is ordinarily employed in the preliminary treatment of these cases is sure to clear up the diagnosis.

Dermoid Cysts of the Ovary.

The ovary may contain a certain amount of epiblastic tissue, such as skin with hair follicles or mucous membrane with embryonic teeth, or these may exist in connection with bone or connective tissue or glandular tissue. These structures may remain in a latent state for a long period of time, and may then begin to develop into what are technically termed dermoid cysts because of the hair and epithelium and teeth which they are likely to contain. Such cysts do not usually develop to any great size. They usually contain more or less hard tissue, such as bone or cartilage, and are consequently prone to give rise to pain on account of pressure. The differential diagnosis of these tumors in no way varies from that in ovarian cysts, and their treatment corresponds to the treatment of the latter; consequently it will not be necessary to give them a separate discussion.

Technique for the Removal of Ovarian Cysts.

An incision is made in the median line, between the umbilicus and the pubis, from one to three inches in length. When the abdominal cavity has been opened the cyst will present as a bluish-white, shining surface. If the

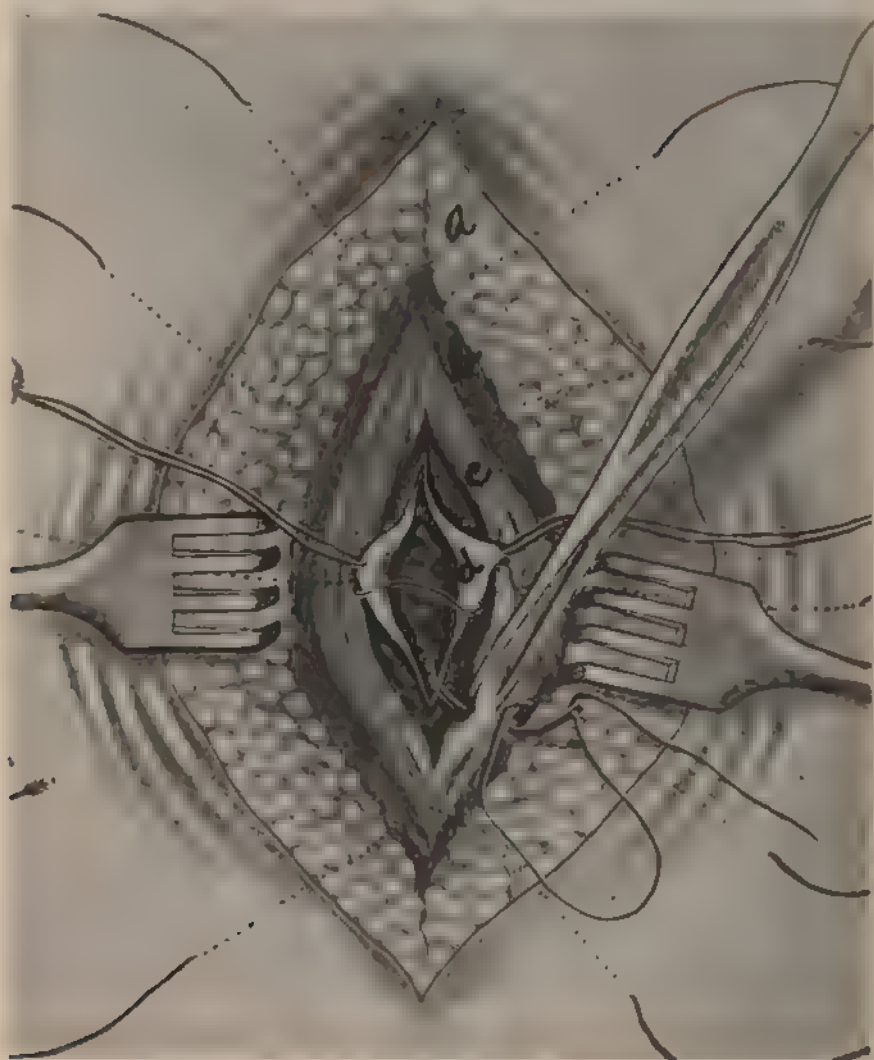


PLATE CXXXIV

ABDOMINAL INCISION THROUGH THE LINEA ALBA BETWEEN THE UMBILICUS AND THE PUBES

The deep silkworm gut sutures being in place (a) subcutaneous fat (b) deep fascia composed of the aponeurosis of the internal and external oblique abdominal muscles (c) the rectus abdominis muscle (d) the peritoneum an transversalis fascia.

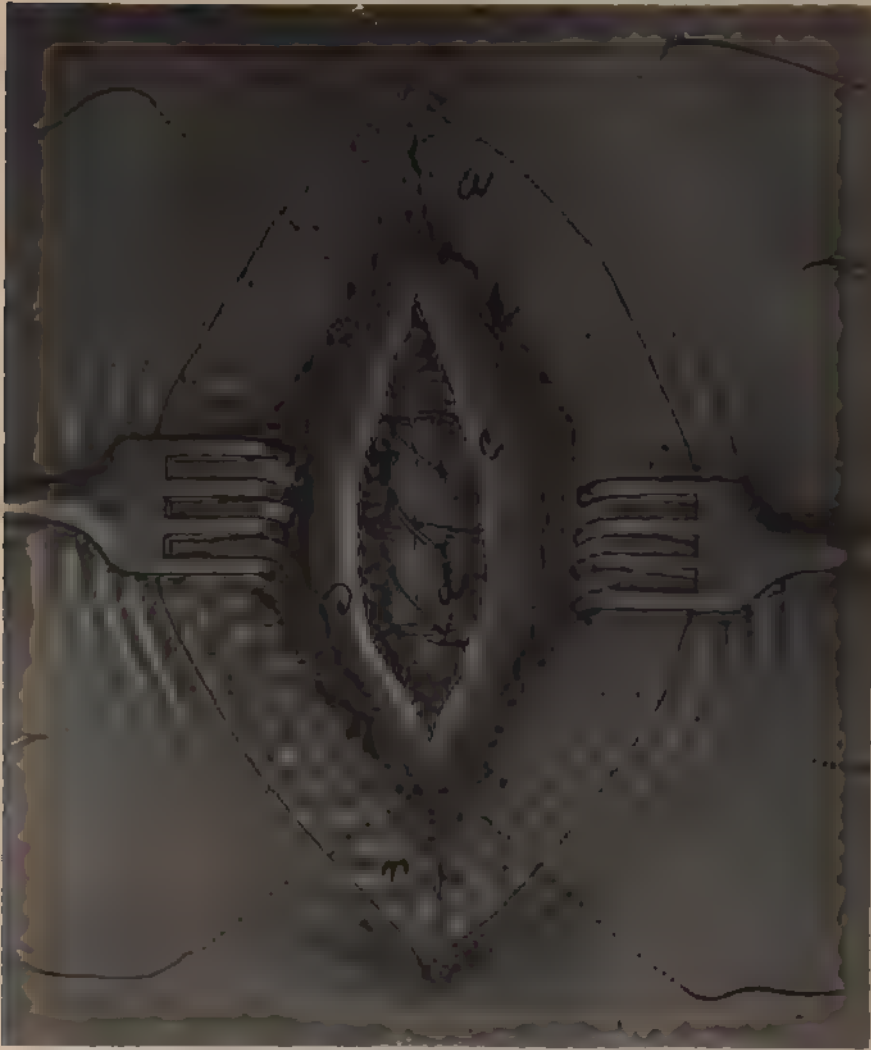


PLATE CXXXV.

CLOSURE OF MIDLINE ABDOMINAL INCISION.

Deep silkworm gut sutures extending through all the tissues down to the layer composed of the peritoneum and transversal fascia are in place but not tied. The peritoneum and transversal fascia (d) have been united by a continuous cat-gut suture care being taken to pass these sutures over the silkworm gut sutures in order that this layer may be drawn up against the lower surface of the recti muscles (c) when these sutures are tied. The rectus muscle (c) (c) on either side is to be united to its fellow with a few interrupted cat-gut sutures, and the deep fascia (b) (b) is to be united with a continuous cat-gut suture. The fat (a) (a) is brought together by the deep silkworm gut sutures.

cyst is simple it will be regular and smooth on its surface; if multiple, one is likely to observe the lobes upon its external surface.

If the cyst is simple, it is best to withdraw the fluid from its cavity by means of a large-sized trocar, which is plunged into it, an assistant pressing the abdominal walls gently against the surface of the cyst in order to prevent the accidental escape of any fluid into the free abdominal cavity.

The fluid contained in these cysts may vary in color from a perfectly clear, limpid, to a yellow or dark-colored kind. The latter color is usually the result of a hemorrhage into the cavity of the cyst and ordinarily occurs in cysts which have been subjected to some form of traumatism, such as a blow upon the abdomen. Cysts which have previously been tapped frequently contain dark-colored fluid because of some hemorrhage which has taken place into the cavity through the wound made in tapping. Many cysts contain a thick, gelatinous fluid, which, however, is present usually only in case the lining of the cyst has undergone papillomatous degeneration. This substance may be so thick that it cannot be forced through a trocar, and then the abdominal wound will have to be enlarged so that the tumor may be removed entire. This gelatinous fluid is supposed to contain cells which may give rise to the formation of secondary growths upon the peritoneal surfaces, consequently it is wise not to permit any of it to get into the free peritoneal cavity.

The clear fluid contained in ovarian cysts is sterile and harmless, and its introduction into the peritoneal cavity does not result in any harm to the patient.

After the removal of the contents to a sufficient extent to cause the cyst wall to become less tense the same may be grasped in forceps and drawn partly out through the abdominal wound, thus protecting the free peritoneal cavity against the introduction of any fluid. After the cyst has become entirely empty it may be withdrawn through the abdominal wound and its pedicle, consisting of the broad ligament and the Fallopian tube, may be transfixed and ligated with cat-gut or fine silk, and then the tumor may be cut away, care being taken to leave a sufficient amount of pedicle beyond the ligature to prevent slipping.

Throughout the operation there should be as little unnecessary disturbance of the tissues as possible.

The stump which is left after cutting away the tumor may be covered with peritoneum by means of a few cat-gut stitches. It is supposed that this will prevent the forming of adhesions with the intestines, but we believe that after an aseptic operation, in which no traumatism is inflicted upon any of the surrounding tissues, such adhesions practically never occur even if the stump is not covered with peritoneum; while they do occur, notwithstanding this covering, provided the operation is septic or traumatism has been caused to the surrounding tissues.

If the cyst is multiple, composed of many small cysts, the trocar may be carried from one to the other of these without being withdrawn from the original puncture, provided these separate cysts are large enough to make such practice feasible. If the cysts are too small it is better to enlarge the abdominal wound sufficiently to permit the removal of the tumor *in toto*. This should also be done in case of a papillomatous cyst, or a cyst containing fluid too thick to be forced out through the trocar. The pedicle of such cysts should be tied and the tumor removed in the manner described for the removal of simple cysts.

It is wise always to examine the opposite ovary at the time of operation, because it frequently happens that the second ovary contains a small cyst which, if left undisturbed, will enlarge and require a second abdominal section. Should the fellow ovary contain cysts of any size in a patient over forty years of age, it is wise to remove the entire organ, together with the Fallopian tube, according to the method described. In a younger patient it is usually better to leave at least one-fourth or one-half of the ovary, making a conical excision of the diseased portion and closing the surface caused by this excision by means of fine cat-gut stitches. This will ensure the normal functions of the ovary, which is of great importance to a young patient.

It is well in these cases to examine the vermiform appendix, because remnants of disease may exist in this organ indicating its removal, which can be accomplished without danger to the patient, according to the methods described in the section devoted to appendicitis.

The abdominal wound is closed in the usual manner, care being taken to unite corresponding layers.

It is our practice to split the inner fascia of the rectus abdominis muscle on each side and to unite the wound by inserting deep silk-worm gut sutures grasping the layers down to the transversalis fascia, and then applying a separate row of continuous cat-gut sutures to the peritoneum and transversalis fascia, uniting the recti muscles with a few interrupted cat-gut sutures; then uniting the deep fascia, the aponeurosis of the external and internal oblique muscles, by means of a continuous cat-gut suture; then tying the silk-worm gut sutures and applying a row of coaptation stitches to the skin, as illustrated in Plates CXXXIV and CXXXV.

Complications.

The most common complication of ovarian cysts affecting the method of operation is the presence of adhesions. These may exist between the ovarian cyst and any one or more of the intra-abdominal organs. The most common adhesions are to the omentum, the anterior abdominal wall, and to the intestines. It does not matter to what portion an ovarian cyst may be adherent, it is always wise to *expose* the adhesion before an attempt is made to *dispose* of it, because although it may occasionally become necessary to lengthen the abdominal incision for this purpose, still this is of slight importance as compared to the benefit the patient derives from having this portion of the operation performed in plain sight. These adhesions frequently contain very large veins and their injury results in a great loss of blood, which is in itself undesirable and complicates the operation by covering the tissues so that they can be recognized with less ease. It is usually best to grasp long adhesions between two pairs of forceps, to cut between these, and to ligate the portion which is not connected with the uterus, and then drop the adhesions into the abdominal cavity. If the adhesion is to the intestine or other abdominal organ it is usually possible to select a point at which these tissues can readily be separated from each other, because there seems to be a union between the peritoneal surfaces which is not firm and can easily be disturbed if one succeeds in finding the point of cleavage. It is well to cover at once with peritoneum any abraded surface which is caused by this separation, so as to prevent future adhesions. This is especially important if the abraded surface is on the intestine. If this precaution is not observed a perforation may readily occur.

ABDOMINAL HYSTERECTOMY.

The removal of the uterus is in itself one of the simplest and safest abdominal operations in cases in which the condition for which the operation is performed is not connected with troublesome complications. The success of the operation depends upon the appreciation of a few exceedingly simple facts.

In this operation, as in every other abdominal one, the first principle is, of course, the prevention of infection. This may be accomplished very easily, as the only source of infection connected with the operation itself is the uterine canal, and infection from this may easily be avoided with care.

The next important point to be observed is the control of hemorrhage. The uterus is supplied with blood by two small arteries on each side; the ovarian approaching it through the upper part of the broad ligament on each side, and the uterine artery approaching it from each side lower down. These vessels are ordinarily not larger than a good-sized knitting needle, and are consequently of no importance, provided they are recognized and carefully ligated. The method to be employed for the control of hemorrhage will depend upon the choice of plan for removal; with the uterus, the Fallopian tubes and ovaries, which is always indicated in patients over forty years of age; or the removal of the uterus without the ovaries and tubes, indicated in younger patients in whom these organs in themselves are not diseased.

If the ovaries and tubes are to be removed with the uterus, two pairs of long-jawed, strong hemostatic forceps should be applied to the broad ligament, side by side, just externally to the ovary. They should extend parallel to each other with a space of one-half to three-fourths of an inch between them. The points of these forceps should extend to the body of the uterus. This should be done alike on both sides; then the tissue between these forceps is severed and the uterus, ovaries and tubes, grasped by the two pairs of forceps which are nearest together, can be elevated. The broad ligament is then severed farther down toward the cervix, until the uterine artery is exposed. This is grasped by a separate pair of forceps on each side; then the peritoneal flap is cut from the anterior surface of the uterus and dissected downwards until a point opposite the internal os is approached. The uterus is then cut away by means of a conical incision. This leaves the mucous membrane lining the cervix at the bottom of a conical space. It is necessary to exercise great care in cutting down upon the uterine arteries in order to approach them on each side of the body of the uterus after they have escaped from the broad ligaments. If this precaution is not taken there is danger of injuring the ureters, which pass through the broad ligament near this point.

If the operation is performed for the removal of a myomatous uterus great care must be taken in making the anterior peritoneal flap, because it frequently happens that the bladder is carried a considerable distance up over the anterior surface of such a uterus, and if care is not exercised in performing this part of the operation this organ is likely to be injured.

It is necessary to be careful in sponging the surface of the uterine stump not to carry any infectious material in the mucous membrane lining this stump to other portions of the abdominal cavity, thus causing infection. For the same reason it is well to eliminate this remnant of the canal from the operation by applying cat-gut stitches to unite the sides of the conical

cavity which has been formed. It is this part of the operation which should be done with especial care, because most deaths occurring after abdominal hysterectomy are due to gangrene of the uterine stump, which results from a faulty application of the sutures. During the early practice of this operation surgeons were taught to fear hemorrhage following hysterectomy, and consequently most of the older surgeons acquired the habit of tying the sutures applied to the stump so tightly as to make gangrene thereof a very common occurrence. These sutures, and, in fact, all of the sutures uniting the surface in hysterectomy, should be tied just sufficiently firm to bring the surfaces together, but not so firm as to cause pressure necrosis. (The observation of this precaution in our own practice has reduced the mortality in abdominal hysterectomy to almost nothing.)

During the past few years we have abandoned the plan of suturing the tissue of the uterine stump and have simply covered this stump by applying fine cat-gut sutures to the peritoneum, thus carefully covering the raw surface of the stump. In this way the danger from pressure necrosis of the part is entirely eliminated and the operation becomes as safe as a simple ovariectomy or appendectomy.

The broad ligament is now transfixed with a cat-gut or fine silk stitch and ligated on each side, care being taken to apply this ligature so that there is no possibility of slipping. Then a stitch is placed around the uterine artery on each side and tied only just firm enough to prevent hemorrhage. Then it is our practice to apply a separate ligature to the end of the uterine artery grasped by the forceps on each side. This does not seem necessary, but we continue to do this as a result of the old superstition concerning the likelihood of hemorrhage.

The entire wound should now be sutured from side to side, so that every portion is covered with peritoneum. This completes the very simple operation; the four points to be borne in mind being:

1. The avoidance of infection.
2. The protection of the ureters and bladder.
3. The careful control of hemorrhage.
4. And (most important of all) the prevention of gangrene of the stump by avoiding too firm tying of sutures.

In case it is desirable not to remove the ovaries and tubes the operation is done in the same manner, with the exception that the control forceps are applied to the broad ligament directly along the side of the uterus, leaving the ovaries and tubes to the outer side of the outer forceps.

SPLITTING OF THE UTERUS.

In case it is difficult or impossible to apply the forceps to the broad ligaments because of the presence of tumors or adhesions, or both, conditions which occur occasionally, the operation may be greatly facilitated by inserting a strong pair of tenaculum forceps in each horn of the uterus, having an assistant make quite firm traction upon these, and then splitting the uterus longitudinally down to a point opposite the internal os. The tension upon the forceps in the horns of the uterus prevents hemorrhage from the cut surfaces.

Of course, the same precaution must be used against injuring the bladder on the anterior surface of the uterus, if it extends above the normal position, that was mentioned in the operation just described.

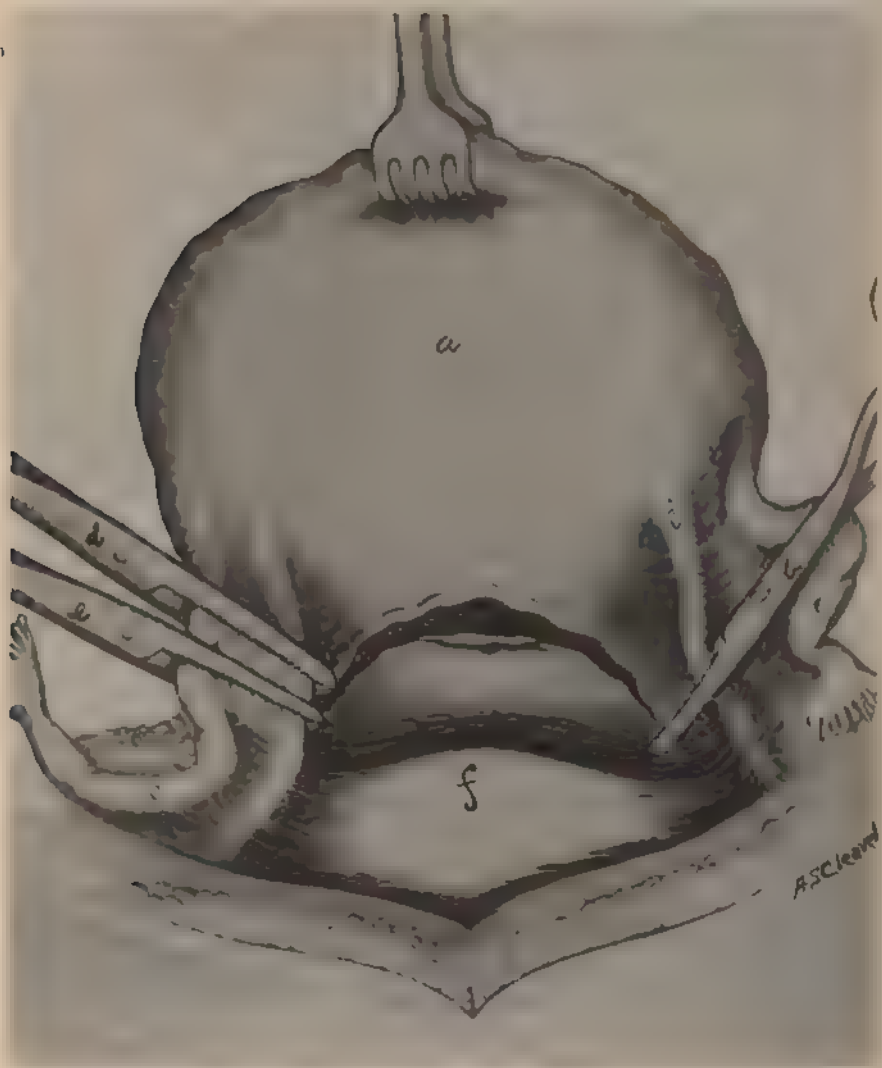


PLATE CXXXVI

ABDOMINAL HYSTERECTOMY

a uterus, *b* forceps on broad ligament, *c* Fallopian tube, *d* forceps on uterine side of broad ligament, *e* forceps on ovarian side of broad ligament; *f* bladder; *g* round ligament, *h* ovary.

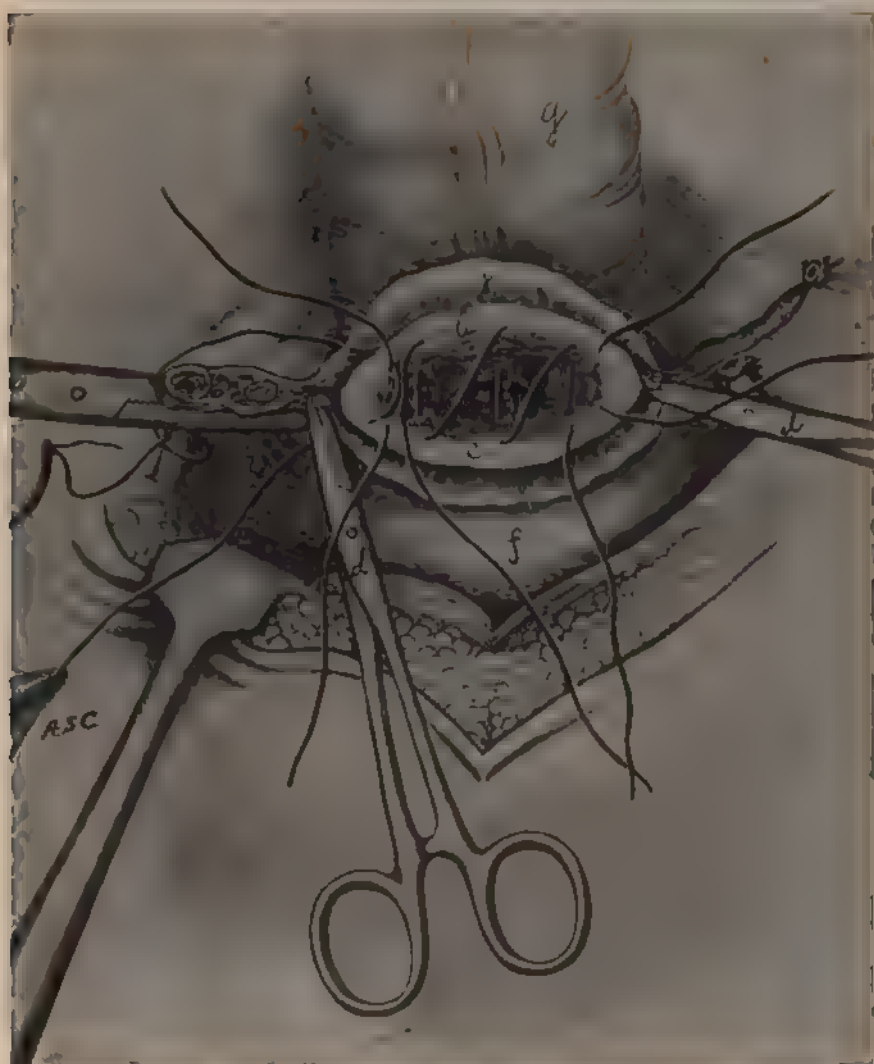


PLATE CXXXVII
ABDOMINAL HYSTERECTOMY

b posterior flap of uterine stump, *c* anterior flap of uterine stump; *d* forceps on uterine artery; *e* forceps on broad ligament, *f* bladder; *i* round ligament; *j* peritoneal flap for covering stump of uterus, *g* colon



PLATE CXXXVIII
ABDOMINAL HYSTERECTOMY

b suture closing in entire surface with peritoneum, *c* Fallopian tube; *f* bladder; *g* flaps of uterus, *h* colon, *i* ovary. To the right the plate shows the ovary and tube removed; to the left they have been preserved

When the internal os has been reached a slight lateral incision is made on one side to a point at which the uterine artery is exposed. The broad ligament, together with the uterine artery, is then grasped from below by means of strong forceps, and the uterus is cut away to the inner side of these forceps. Another pair of tenaculum forceps is inserted in the lower end of the half of the uterus under consideration, and tension made upon this as well as upon the tenaculum forceps in the horn of the uterus on this side. Care must be taken not to relax upon the other pair of tenaculum forceps for fear of causing a hemorrhage upon the half of the uterus not immediately under consideration.

After the lower end of the uterus has been loosened it is an easy matter to grasp the remaining vessels in the broad ligament by means of clamps, and remove the half of the uterus together with the tumor it may contain. If the Fallopian tube or ovary are also in a pathological condition they can readily be removed with this portion of the uterus. The same steps are taken upon the opposite side.

After the uterus has been removed the vessels are ligated precisely as in the operation which has just been described. The stump of the uterus is disposed of in the same manner, and, in fact, the remainder of the operation is in no way different from that which has just been outlined.

Adhesions.

If there are adhesions between the uterus, or the ovaries and tubes, and some other abdominal organs, these must be loosened with great care and all bleeding points carefully ligated, and all abraded surfaces carefully covered with peritoneum by means of Lembert sutures. Especial pains must be taken in covering large abrasions upon the small intestine, due to the necessity of loosening extensive adhesions. Whenever possible it is wise to make transverse closures of these abraded surfaces for fear of causing a narrowing of the small intestine, which, however, is not very likely to occur because of the elasticity of the peritoneum. If any abraded surface in the pelvis cannot be covered with peritoneum it is wise to place the sigmoid flexure upon this surface, and, if necessary, to fasten it by a few fine cat-gut stitches. The abdominal wound is closed in the usual manner.

MYOMECTOMY.

Generally speaking it is proper to make a hysterectomy for any cases of fibroid tumors of the uterus in patients of forty years of age or over, in whom this operation seems to require the least amount of traumatism. In younger patients, whenever possible, the excision of fibroid tumors of the uterus, without the removal of the uterus itself, should be practised, even though the operation be connected with greater difficulty and with greater traumatism. It is surprising how easily fibroid tumors may be enucleated from the uterus even when deeply-seated, and if traction is made upon the organ this operation is not connected with much hemorrhage.

If the tumor is in the superior portion of the uterus the transverse incision should be made and the tumor enucleated. Here again the same principle should be applied that has been mentioned in connection with the closure of the stump in abdominal hysterectomy. The space from which the tumor has been removed should be closed by means of fine cat-gut sutures which are tied just firmly enough to bring the surfaces together, but not sufficiently firm to cause pressure necrosis. As many rows of these sutures

as are required to close the entire cavity should be employed; their number is of no special importance.

When the outer wound in the surface of the uterus is reached it is important to extend the suturing a little beyond each end of the wound because this will overcome the troublesome oozing which frequently occurs from the very ends of the incision in case this precaution is not taken.

If the uterine cavity is opened during the operation, it should be carefully sponged or curetted and a folded piece of rubber protective tissue passed through the uterine canal into the vagina for the purpose of drainage. In this case the first row of sutures should pass down to, but not through, the mucous membrane, for fear of infecting the deeper tissues in the uterus. The danger of infection from the uterine canal in these cases has been greatly over-estimated, and we believe that in cases in which there has apparently been such an infection it has resulted from the fact that the sutures which were applied for the purpose of protecting the wound in the uterus were tied too firmly and gave rise to pressure necrosis. In case a large fibroid has developed in the broad ligament, so that after its removal there remains a large raw surface, this should be covered with peritoneum, but if the uterine cavity has been opened during the operation, or if the rectum or the sigmoid flexure have been disturbed, it is best to insert a small glass drain or a cigarette drain into the angle of the broad ligament next to the uterus and to permit this to pass out of the lower angle of the abdominal wound. It may be removed in two to five days.

PYOSALPINX.

Clinical Example.

This case is typical of the disease under consideration. The patient is twenty-three years of age, married fourteen months, and gives the following history:

She suffered from mild attacks of all the contagious diseases of childhood, but experienced no unfavorable after-effects. Menstruation began at the age of fourteen, was regular and painless, and the patient's health was excellent until a short time after her marriage, when she suddenly experienced severe pain in the lower portion of her abdomen. She had previously observed the presence of leucorrhea and a mild attack of cystitis, to which she gave no attention. After remaining quiet for two days, taking hot douches and a cathartic and applying heat to the abdomen, the pain subsided and she was able to be up and about, but since that time she has never felt perfectly strong and well. Her next menstrual period was characterized by severe pain, lasting for two days and leaving her slightly worse than before. She felt feverish during the entire period of menstruation. She has continually grown worse, suffering from severe pain every few days, and during each successive menstrual period having an attack more severe than the preceding. During the past two months she has scarcely recovered from the effects of one attack before experiencing the next. At the time of her marriage she was strong and vigorous and in every way in excellent health.

Present Condition.

Anemic, somewhat emaciated having lost twenty pounds during the past year. Her appearance indicates that she has suffered severely. Skin is rough and her color is bad.

Physical Examination.

All organs, with the exception of the pelvic, are normal. A pelvic examination reveals the presence of severe induration throughout the pelvic floor. In the left broad ligament there is a mass as large as a man's fist. The right broad ligament contains a mass about one-half as large. The cervix of the uterus is enlarged to twice the normal size; it is hard and edematous. Bimanual examination seems to reveal a slight amount of fluctuation in the left side.

Upon rectal examination there is found an indurated area opposite the cul-de-sac of Douglas, which renders this portion of the bowel quite rigid. The patient complains severely of pain during both the rectal and vaginal examinations. Upon bimanual examination the abdominal muscles contract to protect the inflamed tissues underneath.

Diagnosis.

The history, as well as the physical investigation, indicate the presence of an infection involving the uterus, Fallopian tubes and pelvic peritoneum. This is undoubtedly gonorrheal in origin, because of the time of its occurrence, the presence of leucorrhea and cystitis, and the physical evidences.

Upon inquiry we have determined that the husband suffered from an acute specific urethritis two years ago, from which he recovered after four months, but that he occasionally noticed a slight amount of secretion after some indiscretion in diet or over-exertion. About one week after his marriage he noticed a slight recurrence of this condition, which, however, disappeared after a few days.

It is likely that the infection advanced slowly through the uterine canal and through the Fallopian tubes and that the fimbriated extremities of the latter organs have become adherent to the ovaries and thus become occluded, and that pus has accumulated in the distended Fallopian tubes.

The patient has received local treatment almost constantly since the beginning of her illness, by means of hot douches, the application of tincture of iodine and nitrate of silver to the uterine canal and the cervix, and by the application of vaginal pads saturated with glycerine and ichthyol; but none of these remedies has been of any permanent benefit.

Treatment.

During the early part of the disease it is best to make use of non-surgical means.

1st. Because many severe infections of this form recover completely under this treatment and later go through normal pregnancies provided reinfection is avoided.

2nd. Because surgical treatment is exceedingly dangerous during the early portion of the disease, while it is quite safe later on.

3rd. The patient is not exposed to any risk because of the postponement of operation, provided the internal treatment is carried out properly and rest in bed is insisted upon.

The infection affects a relatively small and a safe portion of the peritoneal cavity—the pelvic portion. If it is confined to this region the worst possible consequence will be a circumscribed abscess which, from its location, may either become absorbed, or remain encapsulated, or it may rupture into the rectum, the bladder or the vagina. If undisturbed the rupture will practically always take place into the rectum if it occurs at all, which is, of course, the most favorable direction.

The Circumscribed Infection.

Anatomically the arrangement is most perfect for the development of circumscribed abscesses.

If the infection advances slowly the fimbriated extremities of the Fallopian tubes will become adherent to the ovaries or to the floor of the pelvis, and then the infection will be confined to one or to both tubes. It may remain in this position, dilating the tubes until they attain a considerable size, or they may become distended beyond their capacity and rupture and infect the surrounding tissues. In this event adhesions have usually formed before the rupture takes place. These most commonly exist between the tube and the omentum or cecum, or sigmoid flexure of the colon, or some loop of the small intestines, or several or all of these. It is very seldom that an abscess of this kind ruptures into the free peritoneal cavity except as the result of a severe strain or a traumatism.

With a circumscribed infection the conditions are very similar to those described with the infection due to perforative or gangrenous appendicitis, and consequently the early treatment should have the same end in view as has the non-surgical treatment of acute appendicitis, namely, the confinement of the infection to the vicinity of the tissues originally involved.

The physiological elimination of the infected area in the condition under consideration is almost perfect because the omentum will apply itself to the surface of the tube, the sigmoid flexure will apply itself above and to the left, and the cecum and appendix to the right. If there is still a small area left it will be occupied by some portion of the small intestine, and as all of the tissues which have been mentioned, except the small intestine, are relatively fixed, the infection is likely to remain circumscribed unless it is carried by the small intestine from its original area to other portions of the peritoneal cavity. This can be prevented by inhibiting peristaltic motion, which, as has been shown before, may be accomplished by the prohibition of all food and cathartics by mouth and, if necessary, by the addition of the use of opium. If the stomach contains food or mucus this should be removed by gastric lavage.

It should be remembered that where neither food nor cathartics are given by mouth, opiates may be administered either by enemata or hypodermatically with safety to the patient.

Large hot vaginal douches frequently administered are a source of great comfort and are of undoubted benefit to these patients. The douches should be given as hot as they can be borne. The patient may be nourished by the use of nutritive enemata, which have been described herein before.

There is an important advantage in first treating all cases of this class by the method just described, aside from those mentioned early in the consideration of this subject, owing to the fact that the virulence of the micro-organisms causing this infection will be very greatly reduced if the infection is compelled to remain circumscribed; in other words, we make use of the principle of rest in the treatment of this infectious disease the same as we do in the treatment of like conditions in other parts of the body. If this state of rest is continued for a time the infection becomes so thoroughly circumscribed that the pus itself will ultimately destroy all of the micro-organisms which it contains, and when examined will be found perfectly sterile.

An operation performed after the pus has acquired this condition of sterility is of course relatively very much safer than if done while the pus is still full of living pathogenic micro-organisms. It is likely that in many cases in which it was supposed that a re-infection took place from the pus that existed in a circumscribed abscess, there was in fact a re-infection through the uterus. The occurrence of such re-infection should, of course, be carefully guarded against.

Although a large majority of cases in which there is but a single infection of the Fallopian tubes will recover fully, or to such an extent that it is impossible to determine the presence of any pathological condition by physical examination, there will always be many who have either had repeated infections or have not recovered fully from a single infection, and these cases can be relieved permanently only by a surgical operation.

Operative Technique.

The operative treatment must be planned so that none of the clean portions of the abdominal cavity become infected during operation, so that all of the disease is removed, and so there will be no serious secondary conditions developed as the result of the operation.

To prevent the infection of portions of the peritoneal cavity not involved, it is wise to make the abdominal incision sufficiently long to enable the surgeon to perform the necessary manipulations in sight. In severe cases it is usually best to make the incision from a point an inch below the umbilicus to the pubis. In mild cases it may be considerably shorter. In unusually severe ones it is often best to carry the incision around the umbilicus to the left and a convenient distance above the same.

The operation can be greatly facilitated by placing the patient in the Trendelenburg position, by elevating the foot of the table so that the patient's body rests at an angle of about forty degrees. This causes the intestines to withdraw into the upper portions of the peritoneal cavity, or if they do not take this position by their own weight, the object may be accomplished by pushing the intestine upwards by means of a large, moist, sterile, gauze compress. The intestines should be carefully tamponed away from the seat of the operation, as thus they will not be exposed to infection during the operation, nor to the irritating influence of the air.

The entire operation can now be done without manipulating anything outside of the pelvis, and this portion of the peritoneal cavity is the least sensitive and its manipulation is accompanied by the slightest amount of shock. This is a fact of very great importance, and if borne in mind the patient's suffering may be reduced greatly and her chances of recovery much improved. The further steps of the operation will depend upon the extent of the infection and upon the parts involved, as well as upon the number and firmness of adhesions.

If the Fallopian tubes alone are concerned, forming sausage-shaped bags of pus, the operation will be identical with that described for the removal of ovarian cysts. The broad ligament will be ligated below the mass and a second ligature placed around the Fallopian tube near the uterus and the mass cut away, leaving a sufficient amount of tissue beyond the ligature to prevent slipping. It is well to place a pair of forceps upon the Fallopian tube beyond the point at which this is cut away in order to prevent any leakage from the cut.

Many authorities prefer to excise a conical portion of the uterus to-

gether with the end of the Fallopian tube, and to close this by means of sutures. Theoretically such method seems preferable, but practically there is no difference between the two.

If the adhesions are extensive it is often much easier to place two pairs of forceps upon the Fallopian tube at its point of entrance into the uterus. The forceps should be placed parallel to each other; then the tube cut away between these, which opens the space between the upper and lower fold of the broad ligament. By applying forceps successively upon the broad ligament from within outward, and cutting between, it is usually possible to enucleate the pus tube without the danger of rupturing it. In many cases the uterus itself seems so thoroughly infected that it may be best to remove it together with the tubes and ovaries. Then the operation described for the removal of the uterus containing fibroid tumors may be employed, great care being taken, of course, to prevent a rupture of the abscess. It is in such cases that the method of splitting the uterus longitudinally is often of especially great value. The remaining steps are the same as those which have been already pointed out.

Here again it is particularly important to exercise care in inspecting the surfaces of the small intestines which have been adherent to the ovaries or tubes, or to the infected uterus, as in loosening these adhesions it sometimes happens that a loop of intestine is perforated, and unless such perforation is carefully closed and the surface covered with peritoneum a fecal fistula is apt to occur and the intestinal contents may cause an infection of the peritoneum, giving rise to a septic peritonitis from which the patient may die.

After all of the diseased tissue has been removed it is wise to cover the abraded surfaces, as far as possible, with portions of the surrounding healthy peritoneum. If this cannot be done the sigmoid flexure should be brought down and placed across this portion of the pelvis, and if there is doubt about this remaining in position it is well to fasten it by means of a few cat-gut stitches. The omentum should also be brought down to this surface. If the operation has been accomplished without causing a rupture of the abscess the surface should be sponged perfectly dry, the gauze tampons placed for the protection of the surrounding intestines should be removed, and it is well to bring the omentum down from the small intestines so that these do not come in contact with the field of operation, because of the danger of distribution of infectious material by peristaltic motion.

If there is any doubt about the aseptic state of the field of operation it is always best to apply some form of drainage. We have found a curved glass drainage tube, half an inch in diameter, placed within a strand of iodoform gauze behind the stump of the uterus in the cul-de-sac of Douglas, and permitted to protrude through the lower angle of the wound, most satisfactory. This tube can usually be removed on the second day, and the gauze surrounding it two days later, permitting the abdominal wound to close perfectly without danger of the formation of ventral hernia.

If there has been a severe infection it may be necessary to leave the tube in place for a longer period of time.

The abdominal wound is closed down to the drainage tube in the usual manner. In many cases it is simpler and better to puncture the vault of the vagina with a pair of blunt pointed scissors or forceps and drain the infected area directly into the vagina by means of gauze or cigarette drains, or by combining these with rubber drainage tubes. In some very extensive cases

we have combined this method with that just described, draining both through the vagina and through the abdominal wound.

These points then are of marked importance:

1st. Banking away of the non-infected contents of the abdominal cavity.

2nd. Manipulation of only the structures contained in the pelvis.

3rd. Care to prevent perforation of the intestine.

4th. Covering of all raw surfaces either with peritoneum or with the sigmoid flexure or omentum, or both.

5th. Drainage in cases in which the surgeon is not positive that the field is aseptic, preferably into the vagina.

After-treatment.

If these patients bear the administration of small, frequently-repeated draughts of hot water well, such should be given. If this causes nausea or vomiting it is best simply to have the patient's mouth rinsed with hot or cold water and not give anything by mouth for two days. At the end of such time beef-tea or one of the various concentrated predigested foods may be given every two hours in small doses. After two days these patients usually bear hot water well. Rectal feeding is generally somewhat dangerous because of the congestion which follows an extensive operation in the pelvis. The alimentary canal should be perfectly empty before the operation, as a result of the administration of two ounces of castor oil on the previous day. If no further food is given by mouth morphine may safely be administered hypodermatically if necessary, to quiet the pain. Of course, in cases which, for any reason, must be operated during the acute attack no cathartic should be given before the operation, for fear of causing the septic material to be carried from its circumscribed location to distant portions of the abdominal cavity by the production of peristalsis resulting from the cathartic.

If for any reason it seems objectionable to perform an abdominal section in these cases, the uterus, ovaries and tubes may be removed by the vaginal route, to be described later. The objection to this route lies in the fact that the conditions cannot be so perfectly determined and one frequently removes organs which might be saved if the abdominal operation were chosen. It also happens frequently that a diseased vermiform appendix is overlooked.

In the criminal classes we believe this operation is indicated much more commonly than among other patients, because re-infection is almost certain to occur if the uterus is not removed together with the other infected organs.

In all of these patients it is extremely important to leave at least a portion of one ovary so long as the patient has not passed the menopause, as if both ovaries are completely removed in young women the patient is likely to suffer from severe nervous disturbances. These may fortunately be avoided by leaving a portion of one ovary.

TRANSPLANTATION OF OVARIES.

In many of these cases in which both ovaries have been removed at a previous operation, great benefit may be secured by transplanting a fairly healthy ovary by the following method: It is best to select for a source an ovary which must be removed because of prolapse in a case in which the fellow ovary is quite normal and in which it seems unlikely that any operation short of removal would result in the relief of the patient. This ovary

may be preserved in sterile normal salt solution for several days or weeks and may then be transplanted, but it is probably better to make the transplantation directly from one patient to the other.

Technique of Operation.

An incision ten cm. long is made over the middle of the rectus abdominis muscle. The aponeurosis is split and also the muscle. Its posterior surface is separated from the transversalis fascia. The ovary is laid open by means of a longitudinal incision. The ovary is then placed in the pocket between the muscle and the transversalis fascia, with the raw surface caused by splitting directed toward the muscle. It is held in place by a few fine catgut sutures, then the split in the muscle is sutured, and then the aponeurosis and skin wounds are closed and an ordinary dressing applied. If the uterus has not been removed and the patient is young, menstruation may be re-established and the nervous disturbances due to the artificial menopause are likely to disappear.

It is of course important to choose an ovary from a patient who is free from syphilis and tuberculosis. It may be well to test the donor with one of the various tests for tuberculosis and for syphilis in order to be quite safe.

ABDOMINAL VS. VAGINAL HYSTERECTOMY.

During the past few years there has been much difference of opinion regarding the advisability of treating the various surgical diseases of the pelvic cavity through an abdominal incision, or through a vaginal incision; the general surgeon, as a rule, being more familiar with the abdominal route than with the vaginal, has usually supported the former, while the gynecologist has more commonly advised the vaginal route for the relief of all conditions that could be accomplished through a vaginal incision. The abdominal route has undoubtedly the advantage of enabling the surgeon to expose the pelvic cavity freely, especially since these operations are performed with the patient in the Trendelenburg position, by means of which the intestines can easily be removed from the pelvis, leaving only the uterus and adnexæ, the bladder and the rectum in this cavity. This route also permits the surgeon to examine the appendix, for disease frequently the concomitant of other pelvic troubles; it also enables him to examine the gall bladder and to dispose of adhesions between the omentum or the intestines and the pelvic organs. The vaginal route has the advantage of being safer in the hands of a surgeon who is familiar with this class of operations, the mortality in all forms of operations performed by this route being exceedingly low.

There is the further advantage in the fact that no external scar is produced by this avenue which is of importance to some patients who are exceedingly sensitive. In order to overcome this objection Pfannenstiel introduced the transverse incision for abdominal section, made in the area covered by the pubic hair which will later hide the scar completely.

VAGINAL HYSTERECTOMY.

This operation is indicated in carcinoma of the uterus so long as this organ is movable and there is no positive evidence of the invasion of any of the surrounding tissues, and no infection of the inguinal lymphatic glands



PLATE CXXXIX

VAGINAL HYSTERECTOMY

The vaginal orifice is held open by means of specula (c) (d). The cervix (a) is loosened from its vaginal attachment by an elliptical incision. The uterine arteries are picked up with a catgut suture (b) and tied. Sutures are inserted on either side (e) for the closure of the wound but left untied until the uterus has been removed.



PLATE CXL.

VAGINAL HYSTERECTOMY.

The orifice is held open as in the previous plate. The peritoneal cavity has been opened in front and behind the cervix and the uterus has been brought down and inverted by means of traction with the cat-paw retractor (c).



PLATE CXLJ

VAGINAL HYSTERECTOMY

The uterus has been removed the left broad ligament is still held with clamp forceps, the ligature being in place but not tied. The clamp forceps have been removed from the right broad ligament (b) and the ligature has been tied. A piece of iodoform gauze has been sutured to the stumps of the broad ligaments with two cat-gut sutures (a).



PLATE CXLII

VAGINAL HYSTERECTOMY

The operation completed. The orifice held open by the specula (c) and (d). The vaginal vault (a) closed by tying the sutures. The iodoform gauze drain (b) in place.

If the organ is no longer movable the patient has lived longer and more comfortably, in our experience, if, instead of removing the uterus we protect the vaginal walls and thoroughly cauterize the entire uterine cavity by introducing cautery irons heated to red heat. The most convenient form of cautery iron for this purpose, according to our observation, is the ordinary soldering iron heated in a tinner's heater, in a coal fire or in the flame of a gas stove. A number of these irons are placed in the flame and are introduced into the cavity of the uterus successively until the entire cavity has become lined with an eschar. An iodoform gauze pad covered with glycerine is then inserted and a retention catheter introduced into the bladder. After the eschar separates the connective tissue which forms during the process of healing contracts the organ and is likely to retard the progress of the disease. Many of these patients improve so much that the surgeon is likely to doubt his diagnosis, and one of our cases, which seemed at the time entirely inoperable and hopeless, lived for a period of nineteen years and died of an intercurrent disease without having had a recurrence of the carcinoma. A number of other cases have lived from three to ten years. Of course, this is not the rule. Most patients have a recurrence within one or two years, to which they succumb.

Importance of Early Diagnosis.

The most important point regarding the treatment of carcinoma of the uterus, however, is early diagnosis and immediate treatment. In order to make an early diagnosis we believe it is important that the surgeon should make a careful examination in every case in which there is the slightest suspicion of malignancy. This is true especially at about the period of the menopause, or after the end of this. In almost every case which has come under our care for treatment, there has been a history of uterine hemorrhages more or less extensive. If these hemorrhages occur in a patient fifty years of age, or over, the physician should recognize the gravity of this symptom. If he temporizes without having satisfied himself positively regarding the diagnosis, the chances are that by the time the diagnosis is made the case has passed beyond the stage at which surgical intervention could result in permanent benefit.

Dangers of Diagnostic Sections and Curettement.

If the growth begins in the cervical portion of the uterus, which is its most common origin, then it can be at once discovered upon a digital examination or with the speculum. In case the tissues appear suspicious, with this history and at this age, we believe that a hysterectomy should be performed at once. In many cases in which portions of the malignant growth have been removed for microscopical examination our experience has been that this simple procedure has resulted in the stimulation of the growth to such an extent that even in very recent examples there has been no permanent cure after this method of diagnosis has been employed. We believe that the removal of portions of tissue for microscopical examination prior to operation should be most strongly condemned. The same is true if hemorrhages occur in patients after the menopause, in whom neither cervical carcinoma nor fibroid of the uterus can be diagnosed by physical examination. In these it has been the practice to do a curettement of the lining of the uterine cavity and make a microscopical examination of the portions curetted away. Here, again, the danger of infection with carcinoma is so great that we believe the practice should be absolutely abandoned.

Operative Technique.

The danger of infection with carcinoma during the operation should be thoroughly borne in mind, because it is not necessary during the operation to wound any portion which has been infected. If the mass projecting from the cervix has a cauliflower appearance it should be removed by means of a cautery before the operation is begun, because in this way all of the surfaces through which the incision is to be made are destroyed by the heat, and consequently an infection from them is not possible. After the cervix has been cleansed by means of the cautery, if the carcinoma be cervical in character, a pair of volsellum forceps may be inserted a sufficient distance away from the carcinomatous tissues to insure that they do not cause implantation into the latter. The vaginal mucous membrane is then severed circularly around the entire cervix, at a distance of at least two centimeters from the margin of the diseased tissue, by means of a Pacquelin or an electric cautery. We believe that some of the recurrences in our cases have been due to a neglect of this plan. Since we adopted the plan of severing the vaginal mucous membrane with the cautery a number of years ago we have had no recurrences in the vagina, while formerly this was a common location for recurrence.

The uterus is then drawn downward and the dissection carried on in front and behind by means of the cautery until the peritoneal layer is approached, care being taken throughout this part of the operation to avoid injuring the bladder in front and the rectum behind. The location of the bladder may be determined by occasionally inserting a steel sound through the urethra throughout the progress of the operation. After the dissection has been carried to this point by means of the cautery, the peritoneal cavity is opened anteriorly by blunt dissection with the finger and then it is opened posteriorly in the same manner and a piece of sterilized gauze carried behind the cervix into the cul-de sac of Douglas in order to prevent the soiling of the latter cavity from the cervix. The fundus of the uterus is then brought to the anterior opening in the peritoneal cavity, or through the posterior opening, according to the direction in which this can be accomplished most easily. If the fundus is brought down posteriorly, then a piece of sterile gauze should be inserted anteriorly to protect the peritoneal cavity against soiling.

The manner in which the uterus can be brought down most conveniently is by means of the cat's-paw retractors, as indicated in Plate CXXXIX. The ovary and tube on one side are then brought forward into the wound by means of forceps placed upon the broad ligament, or by digital manipulation. Then a pair of heavy, long-jawed compression forceps is applied to the broad ligament beyond the ovary and tube from above downwards, in order to avoid the ureters. These forceps should be so constructed that it is impossible for the tissue to slip out of their grasp. The broad ligament is then cut along these forceps and a second pair of the same kind is applied to the remaining portion of the lateral pedicle containing the remainder of the broad ligament, together with the uterine artery. The remainder of the pedicle is then severed and the uterus is attached now only upon one side. It is then an easy matter to bring out the other ovary and tube and to clamp the pedicle beyond these in the manner which has just been described. The uterus is then entirely cut away. A strand of iodoform gauze is placed over the ends of these forceps in order to prevent them from doing injury by coming in contact with the intestines in the peritoneal



PLATE CXLIII
Uterine Carcinoma

cavity, and then the points of the forceps are shoved up into the peritoneal cavity beyond the vaginal wound. A further tampon is placed in the opening in the vagina, and the outlet of the vagina is tamponed with a piece of iodoform gauze, thoroughly saturated with vaseline, in order to prevent the soiling of the deeper tampons from without. The introduction of a retention catheter and the application of the external dressing completes the operation.

It has seemed to us that there exists a distinct advantage in using the clamps for the purpose of hemostasis in preference to a ligature, because the line of incision through the pedicle, which might be a favorable field for infection with carcinoma, is thus eliminated on account of the sloughing which takes place in the portion contained in the bite of the forceps.

After-care.

The forceps are left unmolested for twenty-four or thirty-six hours, when they are loosened and left in place so that the portion contained in the bite of the forceps may spontaneously retract from the latter. Several hours later the forceps can be withdrawn without giving the slightest amount of pain to the patient, while if they are withdrawn at once upon being loosened the act is usually accompanied by a considerable amount of pain, and occasionally hemorrhage. The most superficial tampon is removed at the time of removing the forceps and fresh vaseline is applied to the parts. The deeper tampons are removed from the fifth to the eighth day, as they become loosened. About the tenth day the speculum is introduced and sloughs which have become loosened by this time are removed by means of dressing forceps. After the last piece of gauze has been removed the patient is given warm douches of some mild antiseptic character, from three to six times a day, care being taken to have the fountain syringe very slightly elevated, so that it is not possible for the stream to injure the adhesions which have formed in the upper portion of the wound. These douches are a source of comfort to the patient and are perfectly harmless if given in this manner. The retention catheter is left in place until all of the gauze tampons have been removed, unless it gives rise to discomfort, in which case it may be extracted sooner and the urine withdrawn by means of catheterization. If the catheter is left in place too long it may become filled with phosphatic concretions, unless a few drops of a dilute mineral acid be given in a considerable quantity of water three to six times daily.

A very comfortable external dressing consists of pads saturated with one part of alcohol and two parts of hot water, and covered with a large piece of dry cotton held in place by means of a T-bandage. Aside from this the after-treatment is the same as in any ordinary abdominal section.

Prognosis.

The prognosis depends upon the extent of the invasion of the tissues by the disease. If the operation is performed early and the cautery used in severing the tissues, and the remaining steps followed, as has been indicated, the prognosis is fairly good. In advanced cases of carcinoma the prognosis is bad.

COMBINED VAGINAL AND ABDOMINAL HYSTERECTOMY.

In more advanced cases the combined vaginal and abdominal operation has been advised by many authorities, because it has been claimed, espe-

cially by Ries, that it will be possible to remove the infected glands by following this method, and thus to prevent recurrence in cases in which the removal by the vaginal route would be useless. It is doubtful whether it is possible to remove all of the infected glands in any case in which the lymph nodes at some distance from the uterus have become infected with carcinoma, but there is no doubt that this operation is more thorough than the one just described and the increased danger is so slight that the operation is at least justifiable in any case in which it seems plain that the disease cannot be removed entirely by the vaginal route, and is not sufficiently advanced to absolutely contraindicate an attempt at a removal.

In our own experience these patients have, however, lived longer as a rule, when we have treated the growth with very extensive destruction with the actual cautery, which seemed to be more far-reaching in its effect than removal by the most careful dissection.

In making the combined operation it is important to remove all of the lymph nodes in the broad ligaments and along the iliac vessels. This dissection is best accomplished by splitting the peritoneum and then dissecting away the fat and the lymph nodes with a gauze pad, according to the method described in connection with the removal of fat and lymphatics of the axillary space for carcinoma of the breast.

All of the raw surfaces are then covered with peritoneum and a gauze or cigarette drain is passed down into the vagina.

It is best to begin the combined operation from below, burning away the vaginal attachment precisely as described in the previous operation and grasping the broad ligaments from below and clamping the lower portion of the broad ligament on each side with strong hemostatic clamps and burning between these and the cervix with the actual cautery. This space is then thoroughly tamponed with gauze and then the patient is placed in the Trendelenburg position and the operation completed through a large abdominal incision, as described above.

The after-treatment is the same as before described.

VAGINAL HYSTERECTOMY FOR NON-MALIGNANT CONDITIONS.

In severe uterine hemorrhage, due to the presence of small uterine fibroids, which cannot be controlled by means of simpler methods, a vaginal hysterectomy is indicated because of its easy execution, that it does not give rise to a scar and is as safe as the abdominal method. In this case it is not necessary to make the vaginal incision by means of the cautery. The remaining steps of the operation are the same as in vaginal hysterectomy for carcinoma, but there is no necessity for leaving the pressure forceps in place, and the patient's comfort is increased by applying a ligature around the portion of the pedicle containing the uterine artery, as indicated in Plate CXL, and a second ligature around the remaining portion of the pedicle, as shown in Plate CXLI, so that two ligatures will take the place of the two pressure forceps in the operation which has just been described. The ligatures should be passed through the pedicle in a manner which will prevent their slipping, because a careless application of ligatures at this point might result in a dangerous hemorrhage. Two cat-gut stitches are inserted through the edge of the wound to one side of the center and left untied, as indicated in Plate CXLI, until the tampon of iodoform gauze has been fastened to each of the two lateral pedicles by means of a small cat-gut stitch.

as shown in Plate CXLI. The tampon should then be shoved up into the abdominal cavity, together with the two lateral pedicles, and then the stitches in the wound are tied, as illustrated in Plate CXLII. This provides for the approximation of the two lateral pedicles and for the closure of the vaginal wound, and also for a sufficient amount of capillary drainage. The approximation of the lateral pedicles is especially valuable in case the operation is performed for the relief of complete prolapsus of the uterus, because in this manner a support for the floor of the pelvis is provided. A retention catheter is inserted as before and the after-treatment is carried out in the same manner, the iodoform gauze tampon being removed between the fifth and tenth day after the operation.

In carcinoma of the uterus which is operated early, before the disease has advanced beyond the tissues of the cervix, this operation is also very satisfactory, but in cases which have advanced beyond the incipient stage we have had more satisfactory results when we have used the clamp.

In place of using the ordinary hemostatic clamps we have used Doud's electric cautery clamp in many cases. This clamp is applied to the pedicle as one would apply an ordinary clamp, then a current of electricity is passed through the clamp for fifteen to thirty seconds, which thoroughly cooks the tissues contained in the bite of the instrument. This at once secures the pedicle against hemorrhage and destroys any malignant tissue which may be contained in the pedicle.

The same clamp is used upon the pedicle formed by the broad ligament in the abdominal operation. By using this clamp the entire operation can be performed without the use of either knife or ligature, the entire surface being covered with cauterized tissue. The results after operations performed with the use of this instrument have been most satisfactory.

The patients do not suffer from shock, neither do they suffer from severe pain after the operation. It is well to mention these facts because they dispose of theoretical objections that might arise.

PROLAPSE OF THE UTERUS.

In prolapsus of the uterus in patients advanced in years, in which the tissues of the broad ligament seem to be fairly substantial, the operation which has just been described, performed without the use of the cautery clamp, has given most satisfactory results. In case, however, the entire vaginal mucous membrane, together with the posterior wall of the bladder and the anterior wall of the rectum, show a tendency to prolapse, these latter structures are likely to continue to descend after doing the operation above outlined, and in such the patients will be but slightly improved unless a more extensive operation is chosen.

The operation which seems to invariably give relief in these cases consists in the additional removal of the entire vaginal mucous membrane and the closure of the entire canal by means of buried cat-gut sutures. The operation which has just been described is performed without the use of the cautery clamp and with the exception that the two lateral pedicles are united to each other broadly by means of buried chromicized cat-gut sutures, and then the entire mucous lining of the vagina is dissected out from above downward, leaving a raw canal throughout. This is closed by a series of buried cat-gut sutures from above downward, and at last the skin at the entrance of the vagina is united by means of a longitudinal suture extending

from a point two centimeters above the meatus urinarius down to the anterior edge of the perineum. In applying the buried cat-gut sutures it is important that neither the rectum nor the bladder be wounded, for fear of producing a recto-vesical fistula.

The after-treatment is the same as after an ordinary abdominal section.

Prognosis.

The prognosis in this operation is very favorable. In prolapsus of the uterus in younger patients it is usually found that the displacement is due to an abnormal elongation of the cervix. There seems to be a tendency on part of the tissues of the vagina to make traction upon the elongated cervix and thus cause a prolapsus of the uterus. The replacement of the latter is of no apparent benefit to the patient, and the support by means of pessaries seems to be of no avail. If, however, the following operation be employed for the purpose of removing the elongated cervix the broad ligaments seem to be able to support the uterus in its normal position, and the organ will remain in its proper position without any further support.

Removal of Elongated Cervix.

A circular incision is made about the end of the elongated cervix and the mucous membrane surrounding the latter is reflected to a point a little below the upper extremity thereof. This point may be at a considerable distance from the lower end of the cervix, as shown in Plate CXLIV, which was drawn from nature, and in which the cervix had reached the length of twelve centimeters. Upon a casual examination it seemed as though there were a prolapse of the entire uterus, but upon careful inspection it was found that only the elongated cervix projected. The mucous membrane was carefully dissected upwards in the anterior and posterior flap, as indicated in Plate CXLV, and severed just below the upper extremity of the cervical canal. As soon as this portion of the cervix had been cut away the uterus showed a tendency to slip up into the pelvic cavity and had to be held down in position in order to complete the operation, which consisted in covering the stump with the mucous membrane removed from the portion of the cervix cut away, as shown in Plate CXLVI. This method insures the formation of a normal cervix.

As has been stated before, the uterus showed a tendency to slip up into the pelvis and take up a normal position as soon as it was released from below, even in this greatly exaggerated case. This, however, is not the history in patients advanced in years who have given birth to a number of children. In these the hysterectomy which has just been described is to be preferred.

In cases in which an obliteration of the vagina is not desirable it is best to perform the abdominal hysterectomy described elsewhere, especial care being taken to construct a substantial floor for the vagina by firmly suturing together the broad and the round ligaments with chromic cat-gut. This can be done to the required degree by carefully overlapping these ligaments. At the same time it is wise to suture together broadly the recti muscles throughout the abdominal incision.

EROSION OF THE CERVIX.

In many patients, but especially in those whose occupation compels them to stand a greater part of the day, the pressure of the cervix upon the

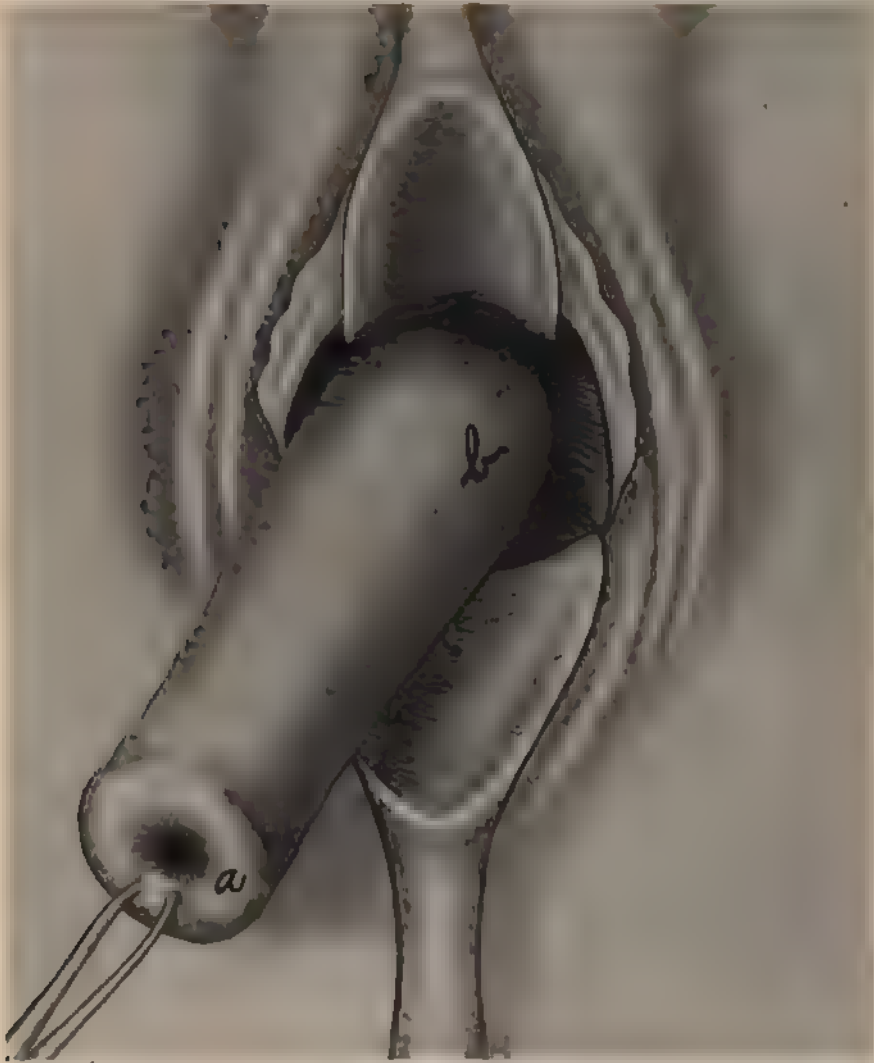


PLATE CXLIV

EXCISION OF ELONGATED CERVIX UTERI.

The elongated cervix (a) (b) withdrawn from the vaginal orifice.

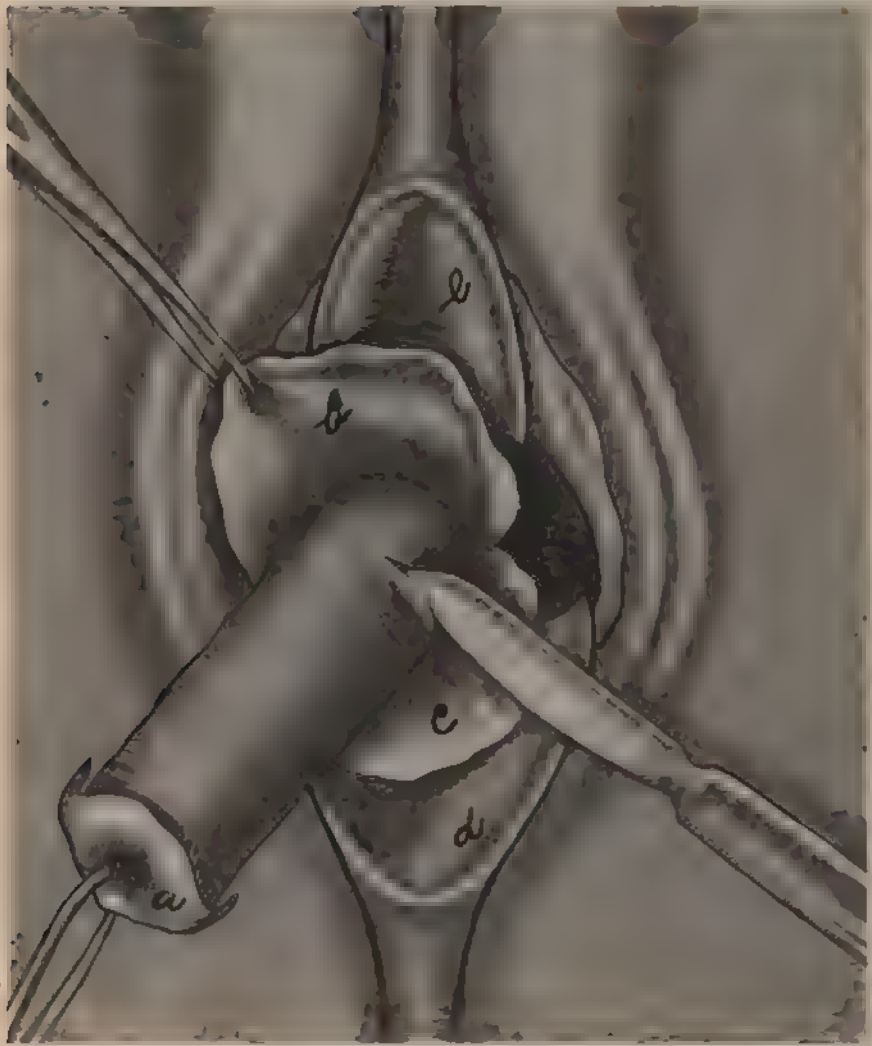


PLATE CXLV.

EXCISION OF ELONGATED CERVIX UTERI

The mucous membrane covering the cervix has been reflected by making an elliptical incision around the cervix (a). Thus an anterior (b) and a posterior (c) mucous flap are formed and the projecting cervix is amputated.



PLATE CXLVI

CLOSURE OF WOUND IN CERVIX

The flaps of mucous membrane are brought down over the stump, sutured to the mucous membrane lining the uterine cavity, and all raw surfaces are covered with portions of the mucous membrane, making a perfectly uniform stump (a)



PLATE CXLVII

AMPUTATION OF LACERATED CERVIX UTERI

The uterus is drawn down with volsella forceps (b). An elliptical incision is made around the cervix. The anterior portion (a) is dissected down to the cervical canal. Then sutures (c) and (d) are inserted uniting the vaginal with the cervical mucous membrane. These are left untied until the lateral sutures have been applied. Then the removal of the cervix is completed.



PLATE CXLVIII

AMPUTATION OF CERVIX UTERI FOR LACERATION

(b), (c), (d) and (e) represent the sutures which unite the mucous membrane of the vagina with that of the cervical canal preventing closure of the latter (f) (g) and (h) (i) represent the sutures on either side which cover the raw surface resulting from the excision of the cervix.



PLATE CXLIX

AMPUTATION OF CERVIX UTERI

This plate shows the operation as completed after all of the sutures have been tied and superficial sutures have been inserted to secure accurate coaptation of the mucous membrane.

tissues upon which it rests results in a condition of erosion, which in turn results in the formation of exceedingly hard cicatricial tissue. This condition is most common in women who have borne children, because in these the uterus has usually not undergone complete involution, and the consequent increase in weight increases the pressure and consequently favors the result in question.

The pressure occurring from the contraction of the cicatricial tissue is likely to produce the symptoms described in connection with laceration of the cervix, and the same treatment is indicated.

LACERATION OF THE CERVIX.

Causative Factors and Symptoms.

In a considerable proportion of patients going through childbirth the cervix of the uterus is lacerated. If the wound is not kept aseptic the healing is bound to be slow, and there must result a variable amount of connective tissue. In case of a second delivery the tissues are less elastic than normal, because of the presence of this cicatricial tissue, and consequently a further laceration is almost certain to occur, which is apt to be more extensive than the previous one. Where the patient can obtain reasonable care during the pregnancy, and during and after confinement, the wound usually heals so perfectly that it requires no further attention, but unfortunately there is a large class of women, comprising the most valuable women in the country, in which conditions are such that ideal care during pregnancy and during the after-confinement, is not possible. This class comprises the wives of the mechanics, artisans, farmers and laborers.

The patient usually gives a history of having been in excellent health at the time of her marriage, of having undergone a variable number of normal pregnancies and usually a certain number of abortions; the confinement has generally been conducted by a midwife; the patient has felt the necessity of caring for her entire household during her pregnancy; she has had but a slight amount of care during and after confinement; she has not enjoyed the benefits of a trained nurse at such time; she began to perform her regular labors within a short period after confinement; and has had the care of her infant and all of her family within a short time thereafter. Usually the first confinements made no marked impression, but later on the patient began to grow old apparently rapidly, to suffer from the sensation of weight in the pelvis, and from pain low down in the back, and she usually complains of feeling tired most of the time. Constipation and lack of strength in securing evacuation of the bowels are usually complained of. Notwithstanding this, the patient frequently has gained in weight, her abdominal walls have become greatly thickened with the accumulation of this fat, but the normal tone of the abdominal walls has been lost. Later on the patient has complained of nervousness, has become irritable, her digestion is impaired, and this condition frequently continues until she is nearly, if not wholly, bed-ridden.

Upon examination the perineal support of the uterus is found to be greatly impaired, the vaginal walls are loose and flabby, the cervix is greatly thickened and edematous, and in a majority of patients there is a laceration of the left side. Occasionally there are several other lacerations of the cervix, all filled with hard, cicatricial tissue. The uterus is found upon bi-manual examination to be considerably hypertrophied, sometimes twice or

thrice the normal size—involution not having taken place after the confinements and abortions. The fundus of the uterus may be retroverted or it may be in a nearly normal position. The entire organ is likely to be somewhat prolapsed and displaced backward.

Preparatory Treatment.

This should be the same as for any ordinary operation, unless the cervix is covered by a septic ulcer. In such instance, it is wise to place her in bed for a few days before the operation is performed, to give large, very hot douches from three to six times a day, and at night apply some antiseptic such as compound tincture of iodine, equal parts of compound tincture of iodine, glycerine and carbolic acid, or a tampon of twenty-five per cent ichthyol in glycerine. During this period of treatment the patient should also receive mild laxatives and light diet.

Technique.

The treatment we have found most valuable in these cases consists in the removal of all of the hardened tissue in the cervix and then covering the abraded surface with vaginal mucous membrane. A broad vaginal speculum is introduced, as shown in Plate CXLVII, and a volsellum forceps applied to the posterior lip of the cervix. With this it is drawn downward and a little forward, and an elliptical incision, including all the hardened tissue in the cervix, is made by a sharp scalpel. The posterior lip is not entirely severed during this stage, but the anterior lip is severed down to the cervical canal. Then two chromicized cat-gut sutures are applied to the anterior lip in the following manner: One-eighth of an inch of vaginal mucous membrane is grasped with a short-curved needle, as shown in Plate CXLVII. The needle at the same time grasps about one-third of the thickness of the underlying muscle; then it is reintroduced into the cervical tissue and the same amount of tissue, including the mucous membrane lining the cervix, is grasped with these sutures. These sutures are then left untied until the remaining portion of the operation has been completed, when their tying will approximate perfectly the vaginal mucous membrane and that lining the cervical canal. These two sutures will serve to manipulate the uterus during the remainder of the operation. The hardened tissue is now completely cut away, leaving the cervix as shown in Plate CXLVIII. Two further sutures are inserted posteriorly, corresponding to those applied anteriorly before the cervix was entirely cut away. These are also left untied. Two additional sutures are then passed on each side, grasping the mucous membrane in front; then to the substance of the cervix to each side of the cervical canal; then to the mucous membrane behind. After all of these sutures have been applied they are tied successively, the outer ones being tied first; the two sutures grasping both the vaginal and the cervical mucous membranes being left to the last. After all of these have been tied the entire abraded surface will be covered, with the addition of a few coaptation sutures, as indicated in Plate CXLIX.

This leaves the cervix in as nearly an ideal condition as possible, and in case of a future pregnancy it is no more likely to become lacerated than it would be had it never had a laceration and reparative operation. In quite a considerable number of patients we have observed the outcome after a future confinement, and in all of these the condition has been most satisfactory.

The chromicized cat-gut to be used should be prepared so as to absorb

within about two weeks. This will dispose of the annoyance of removing the stitches. It is important in this operation that the stitches be not drawn too tightly, as a certain amount of edema is sure to occur, which is greatly increased if the stitches are tied tightly. In this event each stitch will leave a line of pressure necrosis across the surface to be occupied by hard nodular tissue. The removal of the hard connective tissue is the most important benefit the patient derives, and consequently nothing should be done in the operation which might give rise to a recurrence of this state, even to a slight extent.

After the wound has healed the surface should be perfectly soft and covered with loose connective tissue, and the impression upon making a digital examination should be very similar to that one obtains in making an examination of a cervix which has not been disturbed by pregnancy or confinement.

After the operation has been completed the uterus should be replaced in the normal position by bi-manual manipulation. It frequently happens that during operations the uterus has been drawn down considerably, and after the work is completed it is quite out of place, and unless the surgeon takes the precaution of properly replacing the organ at the conclusion of his operation it may remain displaced during the entire time the patient is confined to bed. In this way considerable harm may follow.

The after-treatment consists of rest in bed for at least two weeks; the administration of from three to six large, hot douches a day; a light diet, and the use of mild laxatives.

In almost all of these patients there are other conditions which must be corrected, and the prognosis will be considered in connection with them.

LACERATION OF THE PERINEUM.

This deformity almost invariably accompanies the condition just described, although if the patient has had the care of a physician during confinement the laceration is nowadays usually repaired at once after its occurrence; consequently there are comparatively few old lacerations now in patients who have this proper attention. These cases belong to a class in which the lacerations occurred at a time when the general practitioner was not so careful to examine and repair a torn perineum after confinement as he is to-day, and in the class still being confined by the midwife.

The history is the same as that just given in connection with laceration of the cervix. The laceration may vary in degree, extending quite into the rectum for a slight distance, or for several inches, or only through a portion of the perineal body, or only through the upper or the lower portion—which may be determined upon inspection or by making a digital examination. There may exist at the same time a bulging forward of the rectum between the margins of the lacerated tissues, the mucous membrane of the vagina and the wall of the rectum being carried forward by the pressure of the feces in the latter, forming a rectocele. If this condition be present it usually interferes very seriously with the evacuation of the bowels.

In some cases the skin and mucous membrane may have remained perfectly intact, and still with virtually no perineal support left, because while the skin and mucous membrane were not injured, on account of their elasticity, the transverse perineal muscles were completely torn and the levator ani muscles separated.

Technique.

A transverse incision is made through the septum remaining between the rectum and vagina, and the tissues of the vaginal wall carefully dissected loose from those of the rectal wall, forming a large flap, which is carried forward into the vagina—the entire septum being split from side to side. After the incision through the skin and through a short distance of cicatricial tissue which usually exists underneath the skin, the separation of these flaps may be accomplished most readily by grasping the vaginal flap with dissecting forceps and shoving away this section—the posterior flap—by means of the finger, covered with soft thickness of moist aseptic gauze. In this manner a flap, as shown in Plate CL, can be produced in a few moments. This exposes the tissues on each side which originally formed the perineum, and by carefully uniting these, after the manner to be described, a perineum may be constructed which will be as thorough a support as the original structure. The anterior flap is drawn forward and a row of interrupted tension sutures applied, as indicated in the plate, the first suture beginning directly underneath the skin and grasping the submucous tissues successively and issuing on the opposite side directly underneath the skin. The last suture posteriorly is applied precisely in the same manner.

It will be seen that after the first suture has been tied there will be a perfect floor to the vagina, no matter how deep the laceration may have been. The same is true after the last stitch posteriorly has been tied, there will be a new roof for the rectum, even though the laceration may have extended a considerable distance up into the same. It is plain that if these two stitches are properly applied that a recto-vaginal fistula after this operation is impossible.

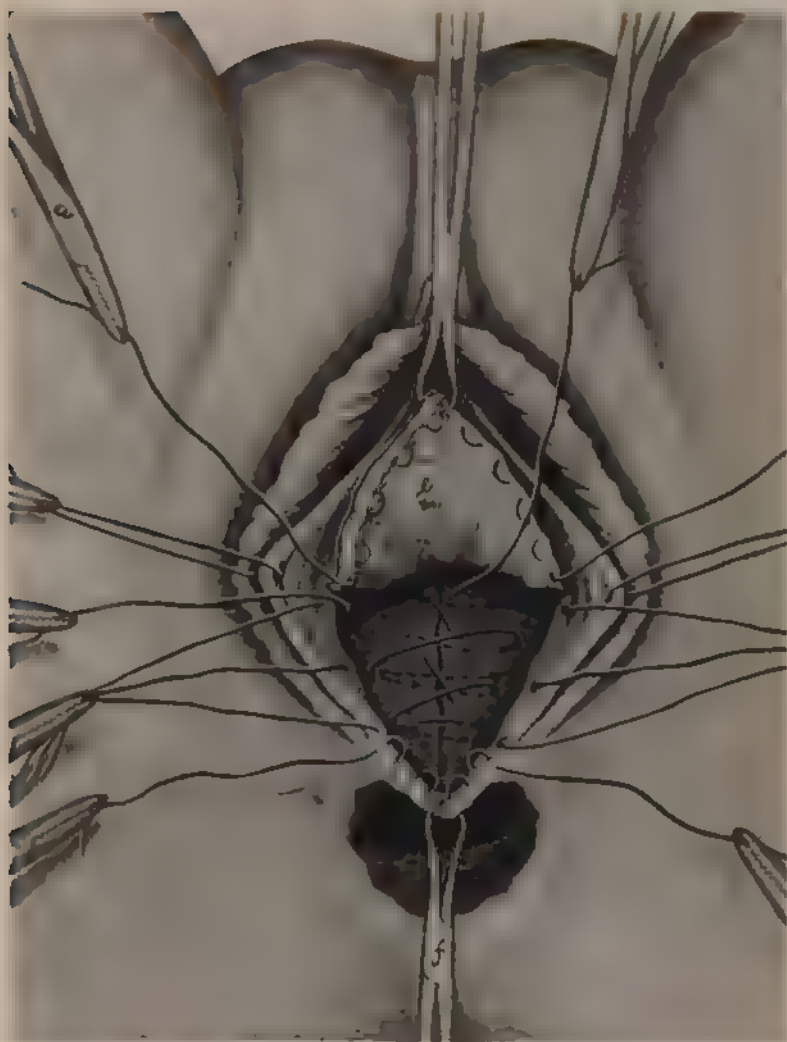
The remaining deep stitches are inserted through the tissues on each side, beginning near the skin and passing down to a point just in front of the rectum, then passing over to the other side in front of the rectum and out through the tissues precisely opposite to the manner of introduction on the other side. From two to five of these sutures are inserted and left untied. Ordinary cat-gut sutures would undoubtedly suffice for this purpose, but in our practice we have used chromicized cat-gut, which will be absorbed after about twenty days. A continuous cat-gut suture is then introduced, as shown in Plate CL, for the purpose of uniting the tissues on one side to the corresponding tissues on the opposite, a small bite being taken with a short curved needle and care being exercised to avoid wounding the rectum.

It is important, again, to draw these stitches very loosely, for fear of causing pressure necrosis. The suturing can be done from above downward, then from below upward, then from above downward again, the same suture being used continuously.

After all the tissues have been placed in accurate coaptation in this manner, the continuous suture is tied and then the stay sutures are tied loosely over this, and then the skin is united carefully with a continuous cat-gut suture. It is clear that a rectocele cannot occur after this operation, because the space originally occupied by the rectocele is completely filled in by the sutures. This operation will give satisfactory results with any one of the various forms of laceration of the perineum enumerated above.

Concomitant Hemorrhoids.

A considerable number of these patients suffer at the same time from



PIATE CL
PERINEORRHAPHY

The recto-vaginal septum has been split and the vaginal flap (c) drawn forward. A silkworm gut suture (aa) has been applied to the anterior flap, which, when tied, will make a new floor for the vagina. A similar suture (b) is applied to the posterior flap. These sutures extend to but not through, the mucous membrane in either case. The sutures caught in the forceps, marked (c), pass through the lateral flaps but they are left untied until each successive tissue on either side has been united with the same tissue on the opposite side by means of the continuous cat gut suture marked (d). After the deep tissues have been united with the silkworm gut sutures (c) are tied.

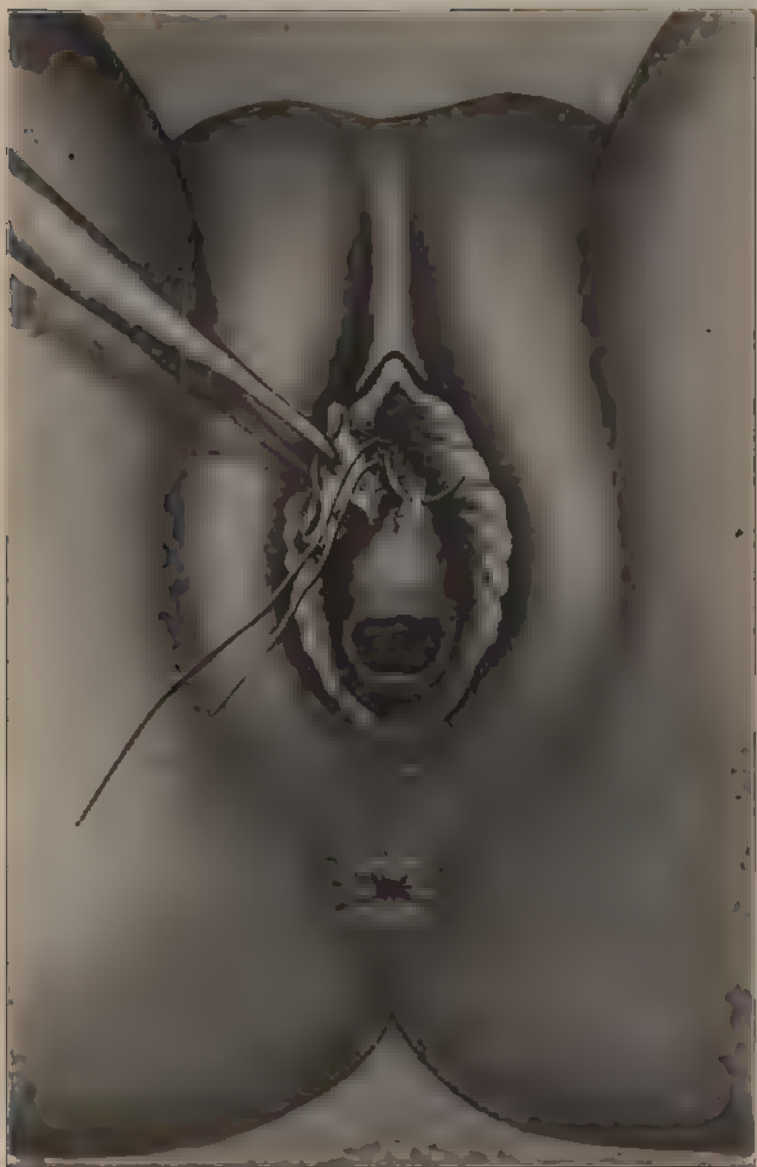


PLATE CLI

EXCISION OF URETHRA

The urethra has been dissected out and drawn forward with forceps and partly severed. The remaining stump is being sutured to the skin with interrupted cat-gut sutures, two sutures being in place and the third one being applied.

hemorrhoids. It is usually sufficient simply to dilate the sphincter and muscles thoroughly before this operation is performed, in order to relieve the patient of that trouble. In cases where there are hemorrhoids of considerable size, however, the operation already described should be employed, but the hemorrhoids on the anterior surface of the rectum should not be disturbed for fear of causing an infection of the perineal wound. In case a hemorrhoidal swelling is directly on the anterior surface of the rectum, this invariably disappears after the perineum has been repaired, which is not always the case with those located on the lateral or the posterior surfaces of the rectum, hence the latter should be removed with clamp and cautery, or with the ligature.

After-treatment.

The patient should remain in bed for at least two weeks, and if possible it is better to have her remain a week or two longer, because the benefit derived from perfect rest is quite important, and if this be prolonged somewhat it is quite worth while. Many of these patients also suffer from gastric disturbances; consequently they are greatly benefited by careful dieting, which may be carried out during their stay in the hospital without interfering with the progress of the recovery from the operation. We have found that many suffer at the same time from an inability to masticate their food properly, because during their long-continued illness they have not given needful attention to the preservation of the teeth. Among the class of working women in whom these operations are especially indicated one frequently finds the mouth filled with decayed roots, and it is consequently a good plan invariably to examine the teeth and during the anesthesia remove any decayed roots that may be present, and to direct these patients after recovery from their operations to have the remaining teeth thoroughly repaired, and in case there are many missing to procure artificial dentures. This will also aid in building up these sufferers very greatly after the return home from their operations.

These patients should be especially cautioned against constipation, as this will aid greatly in securing a satisfactory recovery. If these various precautions are taken the prognosis is usually very satisfactory. A worn-out woman between the age of thirty-five and forty-five years usually recovers to such an extent that within a year or two she will readily be taken to be five or ten years younger than she was before the operation.

In many of these cases there is at the same time a retroversion or retroflexion of the uterus, which may easily be corrected by making bimanual manipulations, but in which the uterus will not maintain its corrected position for any considerable length of time.

Both of the operations which have just been described must usually be performed on the same patient. The result of the amputation of the cervix will be primarily to remove an amount of irritating cicatricial tissue, to remove a suppurating ulcerated surface, and this in turn will result in the natural absorption of the hypertrophy of the uterus, which is present at the time of the operation. Within a few months an hypertrophied uterus upon which this operation has been performed will usually be reduced to an almost normal size. This in itself will increase the likelihood of the organ remaining in its normal position. Then, further, the repair of the perineum will increase this likelihood still more, by supplying additional support for the uterus. If, however, the retroversion or retroflexion persists after these

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operations or if the tendency to these displacements is so great that it does not seem likely that they will be corrected by means of these two operations, then a third procedure is indicated for the direct relief of this condition.

In cases in which this tendency to retroversion and retroflexion exists the round ligaments which normally hold the uterus forward have been so severely stretched that they are no longer able to furnish normal support.

ALEXANDER OPERATION.

An incision three centimeters in length is made directly over the external abdominal ring in the direction of the inguinal canal. It is carried down through the skin and deep fascia to the fascia of the external oblique abdominal muscle. It is important that this incision be carried quite through the deep fascia, because if any portion of this fascia is permitted to remain undivided the surgeon may experience considerable difficulty in locating the round ligament.

After the fascia of the external oblique has been thoroughly exposed, the external abdominal ring can be located by palpation, as it gives the feeling of less resistance at this point than at any other. The fascia of the external oblique is now split in the direction of its fibers at this point, which will expose a small mass of fat directly in the external abdominal ring. If this mass of fat is now grasped by means of a pair of hemostatic forceps, it will contain the round ligament, which may appear as a thread-like band, or may take the form of a cord of considerable size, sometimes as large as two millimeters in diameter. It is important to dissect this out carefully, because if once lost it may be difficult to find it again. This ligament should be examined carefully, and the genital branch of the genito-crural nerve which accompanies it should be separated as its destruction results in a paralysis of sensation in the parts to which it is supplied—which is likely to be the cause of considerable annoyance.

After the round ligament has been freed from its connective tissue attachments, it should be drawn up very gently until the infundibuliform process of the peritoneum becomes apparent. The ligament is then drawn out until it gives the sensation of drawing the uterus against the abdominal wall. Then a pad of sterile gauze is passed through under the ligament and the same steps are carried out on the opposite side. After both ligaments have been loosened and drawn up until this sensation of pulling the uterus against the abdominal wall is felt on each side, then each is relaxed for a distance of about two or three centimeters, in order to give the uterus the desired mobility, and a few stitches of fine chromicized cat-gut are passed through each ligament doubled upon itself in order to remove the slack in the ligament. Then a few stitches are inserted between the doubled ligament and the posterior surface of the fascia of the external oblique.

In case the inguinal canal has been stretched during the operation, the pillars of the canal are drawn together by a few stitches. The suturing of the fascia of the external oblique abdominal muscle completes the operation.

Much has been written concerning the likelihood of suppuration taking place in these operations. We believe that this is due to the fact that a considerable portion of the operation is performed upon tissues with slight vitality, and if with these the surgeon has a tendency to tie his sutures too

tight the resulting pressure necrosis will supply an excellent culture medium for the micro-organisms. If the sutures are tied just tightly enough to secure coaptation, and not enough to cause pressure necrosis, there is no proneness towards suppuration.

After-treatment.

If this operation is performed in connection with the last two just described, no special after-treatment will be required. If it is done for the relief of retroversion or retroflexion of the uterus in cases in which there is no indication for the other two operations, then it is wise for the patient to wear a carefully fitted pessary for at least two months afterwards, so that the adhesions between the round ligaments and their new attachments will have become perfectly firm before any weight is placed upon them.

Prognosis.

If this operation is undertaken only in proper cases, namely, in those in which no force whatever is required in replacing the uterus into its normal position, cases in which the uterus can be retained in its normal position by means of a carefully applied pessary, the prognosis is almost invariably good. Then the operation does not interfere with a future pregnancy, and after delivery the uterus will maintain a normal position, showing that the changes during pregnancy have no tendency to destroy the benefits secured for the patient by this operation. It is important, we believe, that the uterus should be placed in the normal position by bi-manual manipulation before this operation is done. It also seems important that the round ligaments should not be shortened too much, in order to permit the normal mobility of the uterus.

VESICOCELE.

In this same class of cases, as has been stated above, there is also frequently an injury to the anterior vaginal wall, as well as to the posterior, consisting in a separation of the tissues supporting the bladder posteriorly. As a result of this injury the bladder will bulge into the vagina more and more, so that in extreme cases it may project in a sac-like protrusion from the vagina. This will result in retention of a certain amount of urine, in obstruction to the passage of urine, and as infection of this residual urine is likely to occur this condition usually results in the production of a cystitis. If this affection is present only to a very slight extent, the operation just described for the repair of a laceration of the perineum will usually suffice to support the bladder posteriorly, and as a consequence the symptoms resulting from the vesicocoele will subside. If the vesicocoele is pronounced, however, this operation alone will not suffice. It will then become necessary to excise an elliptical portion of the anterior vaginal wall, with its greater diameter extending parallel with the direction of the vagina. This will expose the ends of the torn tissues. The latter may be united by a continuous suture extending parallel with the direction of the vagina. If the lacerated tissues are thus united the mucous membrane of the bladder will contract and the vesicocoele be abolished. It is important, however, that there be no pressure upon the sutures shortly after the operation, and in order to prevent this it is wise to insert a retention catheter directly after the operation, which will insure an empty bladder, and consequently absence of pressure upon the sutured wound. The perineum should be sutured simultaneously, in order to further support the posterior wall of the bladder.

After-treatment.

The patient should be given large quantities of pure water to drink so as to dilute the urine and make it non-irritating, and prevent the accumulation of phosphates in the catheter. A large, hot douche should be given from three to six times a day to keep the vaginal wound clean. In all other respects the after-treatment is the same as following the operations just described.

The retention catheter is removed at the end of one and one-half or two weeks, but if there is any tendency of the bladder to become sufficiently distended to stretch the wound the catheter should be reintroduced.

Prognosis.

The prognosis after this operation is satisfactory unless the deformity has existed for so long a time that the elasticity of the mucous membrane of the bladder has been destroyed.

EXCISION OF THE LABIA MAJORA, MINORA AND CLITORIS FOR CARCINOMA.

In carcinoma of any one of these parts, the excision of the entire part, together with a considerable portion of the surrounding tissues, is indicated, but the most important portion of the treatment to be carried out consists in the careful dissection of the inguinal lymphatic glands, an operation which has been described in connection with carcinoma of the penis.

In our own work we have employed the electro-cautery or the Pacquelin cautery for the removal of these growths, with the hope of preventing the inoculation of surrounding tissues that would, or might, follow the knife. In all of these cases it is important to dissect away the fat and lymph nodes of the inguinal regions, making use of the gauze dissection because in this way recurrence can often be prevented.

Prognosis.

A very extensive and thorough operation done early before the disease has progressed far, promises well for a permanent recovery, which is not the case when the disease is greatly advanced. It is most important to make a very extensive operation when the patient first comes under the care of the surgeon, even though the area involved be very small.

EXCISION OF THE URETHRA.

This operation may be indicated for the relief of epithelioma of the meatus, a condition not very uncommon, or for a prolapsus of the urethra. If it is performed for the relief of epithelioma the same precautions must be observed as in operations for the relief of epithelioma elsewhere. A sufficient amount of tissue must be removed to insure the greatest possible freedom from recurrence.

Technique.

A circular incision is made around the urethra for a sufficient distance to remove all diseased tissues. Then the urethra is dissected out upwards towards the bladder until a point is reached a sufficient distance from the disease; then the remnant of the canal is drawn forward and a stitch applied between this and the outer skin, as indicated in Plate CLI. The urethra is then partly cut off transversely and a second stitch applied a short

distance from the first. In this manner the urethra is successively stiched to the skin and cut off until the entire structure has been severed. In this, as in every operation in which a tubular structure has to be brought forward and attached to the skin, it is best to apply a few stay sutures through the wall of the tube at some distance back from the outer end, and to attach these stitches to the outer structures, so that but little tension is left for the stitches, which are applied immediately through the end of the tube and through the skin. In this manner there is much less danger of retraction from the tube and consequent constriction of its end than if simply a single row of sutures is employed.

Should it seem difficult to introduce a catheter through the opening for the purpose of emptying the bladder from time to time a small retention catheter may be passed while the patient is still anesthetized. This catheter is removed after a few days and the patient is usually able thereafter to empty the bladder spontaneously.

The after-treatment is the same as in operation for cystocele.

VESICO-VAGINAL FISTULA.

Patients suffering from this condition usually give the history of a long continued labor with or without the use of forceps. Following there has usually been retention of urine, and after this incontinence. It is rare that a leakage occurs directly after the delivery, indicating that a rupture of the bladder has taken place at that time. In most instances the bladder wall is crushed only sufficient to become gangrenous after a time, but will support the urine for several days after the confinement.

Prophylaxis.

At this point it might be well to state that in these cases the formation of the fistula might frequently be prevented if, directly after a delivery in which an unusual amount of pressure occurred, the conditions were made favorable for the restoration of the normal vitality of the crushed tissues. This would be greatly assisted by the introduction of the retention catheter, which would keep the bladder constantly empty and consequently improve the circulatory conditions in this organ by removing the intra-vesical pressure. If, however, a portion of the posterior bladder wall and the anterior vaginal wall have sloughed away so that a vesico-vaginal fistula has occurred nearly at the time at which the patient comes under treatment, relief must come from a reparatory operation, unless the fistula be very small, in which case simple continuous drainage of the bladder will result in a healing of the opening.

Technique.

If the fistula be moderate in size it is necessary only to bring in coaptation relatively broad surfaces in order to secure a closure of the aperture. This can be accomplished by splitting the edge of the fistula in its entire circumference, then applying a row of fine cat-gut sutures to the mucous membrane, in order not to permit any portion of the suture to project into the bladder. A second row of sutures is applied to the connective tissue layer between the vesical and the vaginal mucous membrane. A third row of sutures is then applied to the vaginal mucous membrane. The bladder is then drained with a retention catheter and the after-treatment carried out as described in the operation of vesicocoele.

Prognosis.

If the fistula be moderate in size the prognosis is almost invariably good. If, however, it is large the closure must be accomplished by plastic operations, portions of the mucous membrane being taken from various parts apparently most suited for that purpose, but if the entire posterior wall of the bladder has been destroyed its repair will require a great amount of skill in plastic surgery.

RECTO-VAGINAL FISTULA.

This condition is produced either by the opening of an abscess in the recto-vaginal septum into both the vagina and the rectum simultaneously, or by the causes which have been mentioned in connection with vesico-vaginal fistula. The operation for its relief is virtually the same as that for vesico-vaginal fistula, with the addition of a very thorough dilatation of the sphincter ani muscles so as to prevent pressure of the wound from the side of the rectum due to the retention of fecal material on account of a tightly constricted sphincter. The after-treatment in these cases is the same as that just described.

CYSTS OF BARTHOLIN'S GLANDS.

The occlusion of the ducts of Bartholin's glands, causing cysts, is of rather common occurrence, and the result of such occlusion is the same as of the ducts of other glands. An accumulation of the mucous secreted by the gland occurs within the ducts, causing a distension which may increase to such an extent as to give rise to great inconvenience and sometimes to pain. The location of these cysts makes their infection quite likely, and consequently suppurating cysts of the glands of Bartholin is not an uncommon complication. This is especially true of patients who have suffered from gonorrheal infection. These suppurating cysts may open spontaneously, and this may result in a spontaneous cure or in the formation of a fistula or recurrent abscesses.

Treatment.

The treatment may consist in a simple puncture of the cyst, but this will usually result only in temporary benefit, and is consequently unjustifiable, except where the patient must have immediate relief and cannot possibly subject herself to a radical operation, consisting in the excision of the entire cyst. For permanent relief an incision is made over the most prominent portion of the cyst, which is then dissected out from the surrounding tissues. With care it is possible to obtain the line of cleavage between the cyst wall and the surrounding tissues, and with a careful dissection the entire tumor can usually be excised without rupture. The space occupied by the cyst is then closed by means of a few buried sutures of cat-gut and a row of sutures uniting the mucous membrane, and the ordinary dressing applied.

DYSMENORRHEA DUE TO ATRESIA OF THE CERVIX.

In by far the greater number of patients suffering from dysmenorrhea the cause lies in the results of inflammatory conditions above the uterus. In considering appendicitis this subject was discussed, and again in speaking

of pyosalpinx, but there is a certain number of cases in which none of the inflammatory conditions affecting the tubes and ovaries are present and in which the cause of the dysmenorrhea lies in an atresia of the cervix, or in a mechanical obstruction due to a short bend of the body of the uterus upon the cervix, or in an inflammatory condition of the mucous lining of the uterus and cervix. In these patients the trouble may be relieved by thorough dilatation of the cervix, repeated a number of times. The dilatation may best be started by inserting ordinary male urethral steel sounds, beginning with a size sufficiently small to enter the contracted cervix and increasing gradually until the largest size is reached; then introducing a uterine dilator and stretching the cervix as much as it will bear without tearing. The dilator should be left in position under tension, then relaxed, then dilated again—and this repeated many times until the canal remains comparatively wide open after the dilator has been removed. If there is a sharp angle between the cervix and the uterus it is well to dilate the cervix as much as possible without causing any laceration, and then insert a tenotome and transversely cut the ridge opposite the junction between the body of the uterus and the cervix. In case there has been an endometritis which has resulted in the formation of granulation tissue within the uterus and the cervical canal this should be thoroughly curetted away with a moderately blunt curette and then sponged with aseptic gauze. The uterine cavity should afterwards be tamponed with a piece of aseptic gauze moistened with ninety-five per cent solution of carbolic acid. This should be left in place from two to five minutes and then withdrawn. Then the cavity should be tamponed with a piece of gauze saturated with strong alcohol. After this has been removed a piece of iodoform gauze may be carried up into the uterus in order to serve as a capillary drain. More recently we have invariably tamponed the uterus with gauze saturated with Beck's bismuth paste. This tampon is left in position for from two to three days.

After-treatment.

The patient should be kept in bed for from one to two weeks and receive from three to six large, hot douches every day, in order to relieve the congestion resulting from the operation. During the subsequent menstrual periods the patient should receive a mild uterine sedative during each period for a number of months. Patients suffering from this condition are likely to expect pain, and unless some sedative is given a slight amount of pain may be exaggerated by their nervous condition into a serious degree of suffering. On the contrary, if a uterine sedative is given, the patient will be entirely free from distress and consequently soon cease looking for pain during these periods.

The prognosis will depend upon the cause of the dysmenorrhea. If the cause was entirely in the cervix and in the uterus a very satisfactory result may be expected. If, however, it was in the tubes and ovaries, then the result will be entirely negative.

PART X.

SURGERY OF THE EXTREMITIES.

OPERATIONS FOR THE RELIEF OF FRACTURES.

The scope of this work does not comprehend the treatment of fractures, except those in which operative interference is indicated. At the outset we wish to state that operative intervention is not indicated in any form of fracture unless the operator absolutely controls the conditions of asepsis during the operation, because an infection is so much more serious than the fracture itself that if this cannot be absolutely eliminated an incisional operation is, of course, not indicated.

FRACTURE OF THE PATELLA.

If the surgeon thoroughly controls the situation so that he can be certain of asepsis, then in cases of fracture of the patella we believe the operative method is always indicated, as with it the patient may be out of bed in less than one week, he may walk about comfortably in three weeks, and in from six to eight weeks he should be able to follow any occupation he may have had at the time of injury; while without such operative treatment he will be disabled for many months at best.

The following case may illustrate: A young man, forty years of age, fell upon his right patella and fractured it. He had it treated by means of splints and strapping, and obtained a very satisfactory result, which enabled him to pursue his occupation of book-keeper in a large establishment at the end of six months; the knee, however, never became thoroughly strong, so that the patient could not take long walks without becoming exhausted. Two years later he fell upon the other knee and fractured the patella in the same manner. An open operation was at once performed and the extremity placed in a plaster of Paris cast. At the end of one week the patient was allowed to be out of bed. At the end of three weeks he was able to resume work in the office, continuing, however, to wear a cast. At the end of eight weeks his left leg was in a much better condition than his right, which had been injured two and one-half years before.

We have had numerous opportunities of making similar comparisons in fractures of the patella taking place in different persons at the same time, and are convinced that with a clean operator an open method is as safe as the treatment with splints, and has all the other advantages just mentioned.

Technique.

A transverse, curved incision is made with its center three centimeters below the point of the fracture of the patella. This flap is turned up; the blood clots found to be present are sponged away with moist aseptic gauze pads; the two fragments are then placed in accurate apposition; and the

capsule to each side of the fracture is sutured by means of chromicized catgut, which will last about two weeks. A few superficial sutures are then applied to hold the patella in accurate apposition, and the skin sutured over all. A small plaster of Paris cast is then applied and the patient placed in bed, with the extremity elevated. It is important that the extremity should be elevated, because this relaxes the quadriceps femoris muscle and consequently prevents pulling upon the upper fragment.

After six or eight days the patient is permitted to sit up out of bed, and after three weeks he is allowed to walk, with a cast upon the extremity. Five or six weeks after the operation the cast is removed and the patient permitted to walk with a cane. It is neither necessary nor desirable that the patient should walk with a crutch at any time. In case there should be a certain amount of limitation of motion in the knee after recovering from this operation, which, in our experience, has been very rare, this can be overcome most readily by having the patient ride a bicycle, or a tricycle if he is not accustomed to the former. The result is so much better after this treatment than after the methods ordinarily in vogue that we believe it should become a recognized method, only, however, in the hands of clean surgeons.

FRACTURE OF THE OLECRANON.

The recovery from a fracture of the olecranon is ordinarily so much easier, and the conditions after healing are so perfect if the fragments are applied by the use of catgut sutures, that here also an operation is indicated.

Technique.

A longitudinal incision is made directly over the middle line of the olecranon process and the soft tissues are carefully retracted in order to avoid injuring the ulnar nerve. It is important at this point for the surgeon to bear in mind the relative position of the olecranon and the ulnar nerve, as if the operation is performed with the hand in the position of pronation the surgeon may be confused by the fact that ordinarily we carry the relations in our mind with the hand in the position of supination. The nerve mentioned passes between the internal condyle and the olecranon, but when the hand is pronated so as to place the olecranon in a convenient position for operation, then the internal condyle is turned to the outer side. If this fact is borne in mind the nerve may be very easily avoided. Here, again, the fragments of bone are united by means of chromicized catgut, which will last about fifteen days. In case a sufficiently firm hold can be obtained by passing these sutures through the periosteum and the surrounding soft tissues to retain the fragments in perfect juxtaposition that is all that will be required. If this cannot be done a small opening should be drilled through the middle of the olecranon process and through the upper end of the ulna, and a suture passed through this. The arm should be dressed in the extended position by means of a plaster of Paris cast.

FRACTURE OF THE ACROMION PROCESS.

In fracture of the acromion process, in which it is found difficult to maintain the proper position, an incision should be made parallel with the spine of the scapula, the fracture should be exposed with as little dis-

turbance of the soft tissues as possible, and the fractured end sutured in place, if possible, by passing the sutures through the soft tissues. If it is not possible to firmly adjust the fragments in this manner small openings should be drilled into the end of each fragment and at least two chromicized catgut sutures applied in order to secure a perfect coaptation.

FRACTURES OF THE OUTER END OF THE CLAVICLE.

In very rare instances a fracture occurs near the outer extremity of the clavicle which cannot be retained in any reasonable position by means of dressings ordinarily used for this purpose. In such case the most superficial portion of the bone should be sought, namely, upon the line between the attachment of the trapezius muscle and the deltoid, and an incision at this point should expose the fracture, which can then be readily adjusted by means of a few catgut sutures. After these have been applied the skin is sutured and a rubber adhesive plaster applied upward from the chest, covering both fragments and extending backward over the scapula. The arm is then placed in a sling and carried in this position for a period of three to six weeks.

In these cases we now invariably use the Lane plates because they hold the ends in absolute coaptation and produce ideal results.

In the same region occasionally a severe traumatism causes a dislocation of the outer end of the clavicle, loosening its attachment to the acromion process of the scapula, the acromio-clavicular ligaments being completely lacerated. Ordinarily this dislocation can be reduced by means of properly applied rubber adhesive straps, but if such a result is found impossible then the incision which has just been described for the treatment of a fracture at the outer end of the clavicle should be made, the dislocation reduced, and the ruptured acromio-clavicular ligaments carefully sutured with chromicized catgut. The dressing just described in connection with the rubber adhesive plaster dressing should be applied and a second broad strap of rubber adhesive plaster adjusted as follows: Beginning about the angle of the eighth or tenth rib the plaster is passed upwards and outwards, so that its middle portion strikes the end of the clavicle. It is then carried forwards and downwards and passed around the forearm four centimeters below the end of the olecranon process with the arm in the flexed position. In this manner the leverage of the arm upon the adhesive plaster straps serves to hold down the end of the clavicle in position and relieves the tension upon the chromicized catgut sutures.

EPIPHYSEAL FRACTURES.

In epiphyseal fractures in any portion of the skeleton in which, after careful manipulation under anesthesia, it is found impossible to adjust the fragments, it is desirable to resort to an open operation at once—always providing that the surgeon completely controls the conditions of asepsis. The deformities which occur after these fractures are unusually annoying, because of their proximity to the joints. This fact, of course, makes the open operation more hazardous, but the benefits of the operation are so great in cases in which, after careful trial, it has been found impossible to adjust the fragments, that the surgeon is justified in taking the additional

risk. Where the fractures have not been adjusted there will be found a retardation of growth from the epiphyscal line involved, aside from the deformity. Whether this can always be avoided by an open operation it is impossible to say with the relatively small amount of clinical observation upon this subject, but in cases in which the operation has been done the results have been much more satisfactory than in those in which the irreducible deformity has been permitted to persist.

COMPOUND FRACTURES.

In compound fractures the most important point to be considered is the production of conditions as nearly as possible like those in simple fractures. These conditions may be secured most readily by laying the wound open sufficiently to remove the extraneous matter which may have been forced into it at the time of the injury, or by the manipulations which occurred before the patient entered the hands of the surgeon. After the wound has been carefully disinfected and all of the entirely loose fragments removed, those which have some attachment to the periosteum being carefully adjusted, the fragments should be placed in as nearly a normal position as possible, and if it seems likely that this position can be maintained by the use of external splints, then it seems proper that such external splints be applied. If, however, it is clear that this position of the fragments cannot be maintained then the same should be sutured in place by means of catgut sutures.

In our own practice we have for a number of years applied strong tincture of iodine to all of the injured tissues involved in compound fractures, and have then applied strands of iodoform gauze down to the point of fracture, permitting them to project from the outer wound. This has been done because it has been claimed by good authorities that in the presence of iodine, and especially iodoform, the development of the tetanus bacillus is much less likely than under any other form of treatment. Personally, we are well satisfied with this method, being careful, however, to thoroughly cleanse the surfaces with large quantities of hot water and with a 1:2,000 solution of corrosive sublimate. Other surgeons have equally satisfactory results with other methods, and consequently we do not feel justified in giving this as one which should be generally adopted as being better than any other. The dressings should be applied so that they may be removed without disturbing the relation of the fractured ends.

OPERATIVE TREATMENT OF SIMPLE FRACTURES.

During the past year it has been the practice of the authors to operate upon all simple fractures of long bones in which we were unable to restore the normal relationship of the fragments by ordinary means, and in laboring people in whom it was important that their mechanics should not be impaired. In these cases we have used the method of Mr. Lane, of London, which consists in the application of steel plates to keep the fragments in place. During the past eight months we have applied the plates in thirty cases with excellent immediate results in all. We have found that this method of treatment in simple fractures possesses all of the advantages to the patient, claimed for it by Mr. Lane, which are as follows:

(A) The patient is at once relieved of the pain of any movement of the fragments upon one another.

(B) He is freed from the tension and discomfort due to the extensive extravasation of blood between and into the tissues.

(C) It shortens the duration of the period during which he is incapacitated from work, since union is practically by first intention, and consequently very rapid and perfect.

(D) Lastly, and by far the most important, they leave the skeletal mechanics in the condition in which they were before the sustained injury.

This treatment is especially indicated in fractures of the shaft of the humerus and the femur, for in the majority of cases one cannot hold the fragments in accurate apposition with any degree of certainty without operative measures.

This method of treatment should not be used except in a well-regulated hospital where the surgeon can be absolutely certain that every detail of the operation will be carried on in an aseptic manner. It is obvious that where a considerable quantity of metal is to be left in a wound, it is necessary that greater aseptic precautions must be taken than in ordinary operations where foreign bodies are not left in the wound. During the past seven years Mr. Lane has demonstrated in hundreds of cases that a fixed foreign body, when introduced in a perfectly aseptic state, does not cause any irritation or trouble, and that screws placed in the bone under aseptic conditions do not cause a rarefying osteitis.

Technique.

The skin in the region of the fracture is very thoroughly disinfected, and an incision is made through it and superficial fascia at a point from which the fragments may be reached with a minimum damage to the soft parts. The skin in the field of operation should now be excluded from the wound by attaching sterile gauze pads to the divided margin of the skin by means of forceps devised for this purpose.

The deep fascia and muscle sheaths are now severed and then the muscles are separated by blunt dissection until the fragments are reached. All bleeding points should be grasped by rather heavy forceps so that by the time the operation is completed, few if any ligatures will need to be applied. The wound should be carefully freed from the old extravasated blood so that fragments may be inspected. Now by special bone-holding forceps, which have long strong handles, the fragments are placed in accurate apposition so that the normal contour of the bone is absolutely restored. Now while the fragments are held in apposition by means of these forceps, a steel plate which has been perforated by a number of small holes for screws, is placed across the line of fracture. Small holes are now drilled into the bone at points directly opposite the holes in the plate. Small steel screws are then inserted and screwed in tight by means of a strong screw driver. In large bones like the femur and humerus two plates are applied if possible. The plates are rigid and when screwed firm across the line of fracture, they hold the bone very definitely, in fact they do away with all motion between the fragments. As soon as the plates are in place, the wound is closed without drainage, and a dressing is applied immobilizing the extremity.

In applying the plates they should be so attached as to not form a projection beneath the skin, for in that case they might cause pain or incon-

venience, making it necessary to remove them at a subsequent date. In fractures of the femur there are abundant soft parts to cover and protect the plate, but in some fractures of the tibia it is necessary to place the plate subcutaneously. Under such circumstances it is better to remove the plate as soon as union has taken place, and when it is of no further use.

In all of our patients convalescence has been rapid, primary union has taken place, and there has been complete absence of pain following the operation.

UNUNITED FRACTURES.

In the treatment of a large number of ununited fractures we have invariably found that the ends of the fragments were separated by some intervening fascia, muscle or cicatricial tissue. These cases are almost always in patients who have sustained an exceedingly violent injury, so that the ends of the bones have been forced beyond each other with great energy.

Prophylaxis.

In many instances during the original reduction of the fracture one observes the fact that after the fracture has apparently been corrected, the moment the surgeon's grasp upon the extremity is loosened a marked deformity occurs and that the ends of the bones show no tendency to become engaged against each other. This condition is, we believe, frequently an indication that one or the other end of the bone has been forced through some of the surrounding soft tissues, and that the moment tension upon the extremity is relaxed this soft tissue causes the fragments to slip past each other. If this point is regarded and overcome during the reduction of fracture it is believed many cases of non-union may be avoided. The soft tissues are usually forced in between the ends of the fractures at the time of the injury, except in cases of compound fracture in which a considerable portion of bone is entirely lost, leaving only soft tissues between the two fragments.

Cases of non-union should be treated by open operation. An incision is made at some point at which the bone can be approached without interfering with any important anatomical structures. The soft tissues between the ends of the fractured bone are thus completely dissected away, so that the ends of the bone are free with the exception of the connective tissue which has formed over these ends. This connective tissue is then cut away by means of a sharp carpenter's chisel. Frequently the ends of the bone have become rounded, if this condition is present such ends should be cut off for a short distance by means of a saw or chisel, so that the fragments may be placed in perfect apposition. The fragments are now held in contact by screwing on to the side of the bone two steel plates, the technique of which is described under the operative treatment of simple fractures. These plates give rigidity to the bone and keep the fragments in absolute contact with each other, with the result that union usually takes place in a short time.

Clinical History.

Patient forty-five years of age, a machinist by trade. Family history very good. Personal history good, in fact patient had never been sick until time of accident, eleven years ago, when he was kicked by a horse on the



PLATE CLII

X Ray of an ununited fracture of the humerus of ten years' standing. Elbow is at angle of 90° and the lower fragment of humerus is at right angle to shaft of humerus



PLATE CLIII

Same case as shown in Plate CLII, showing Lane plate in place

right arm, which produced a compound, comminuted fracture of the right humerus at junction of lower and middle third. Wound became infected and patient remained in hospital for a period of twenty-two months, during which time he underwent four surgical operations, some pieces of bone being removed each time.

At the time of leaving hospital, wound was completely healed, but there was no union of the two fragments of the humerus. One year later patient was operated upon for the non-union. The ends of the bone were freshened and fastened together by means of silver wire. Again the bone did not unite and the wire had to be removed a few months later because of irritation. Two years later a second operation was performed, the ends of the fragments freshened and again fastened with silver wire, the result being the same as before. Two more attempts were made in the same manner to secure union, but the result was the same each time. The last operation was performed three years ago. Four years ago received a bullet wound in left thigh. The bullet was not removed and has never caused any trouble. During past two years patient troubled some with belching of gas and some distress in epigastrium after eating, otherwise well until up to the present time. Patient comes complaining of a false joint in right arm at a point about three inches above the elbow joint.

Examination.

Patient is well nourished, tongue coated, appetite good, bowels regular, chest is negative, abdomen negative.

Arm.

Distance from right acromion process to olecranon process is $13\frac{1}{2}$ inches. Distance from left acromion process to left olecranon process is 17 inches. Considerable atrophy of muscles of right arm, but muscles of right forearm are about normal. Patient had good use of forearm, the false joint in the humerus acting as the elbow joint. The false joint in the humerus was ten inches distant from the right acromion process. The lower fragment of the humerus which was about $3\frac{1}{2}$ inches long remained at right angles to the bones of the forearm. By grasping this fragment firmly and moving the forearm it was found that there was about twenty degrees motion in the elbow joint. When the forearm was extended the lower fragment assumed a transverse position to the long axis of the humerus as shown in Plate CLII.

Technique.

Patient was anesthetized and an incision made on the outer surface of right arm on the false joint. The musculo-spiral nerve was exposed early in the dissection. It was markedly enlarged and imbedded in connective tissue in the region of the false joint. The nerve was dissected free and retracted. All of the connective tissue was dissected away, the ends of the bone were freshened by sawing off the rounded ends, the two fragments approximated and held in apposition by screwing two steel plates on the humerus. This was accomplished with considerable difficulty on account of the shortness of the lower fragment and the limited motion in the elbow joint. It was necessary to place the forearm at right angles to the arm in order to bring the fragments in juxtaposition, making it rather difficult to apply the plates to the short lower fragment. After the plates were applied, the wound was closed and a cast applied with forearm at right angles to arm. Plate CLIII shows the arm with plates in place.

Cast was removed at end of twelve weeks at which time the bone seemed to be very firm. The arm was left without a cast and was examined again in a week. At this time union seemed very firm, there was absolutely no pain or tenderness and there was about thirty degrees of motion in the elbow joint.

OSTEOMYELITIS.

Patients suffering from acute osteomyelitis usually give a history of a sudden attack of pain, most frequently at the point of entrance of the nutrient artery or near one of the epiphyseal extremities of one of the long bones. This attack usually occurs after exposure to wet and cold.

In many cases it is possible to trace a history of follicular tonsillitis as the source of the infection. The pain is extreme upon pressure and most extreme early in the disease at one particular circumscribed point. The patient has high fever and feels thoroughly ill, having the general appearance of one suffering from acute sepsis. The pain becomes more and more diffuse and the extremity becomes swollen and later on edematous and reddened, and ultimately fluctuation will appear. In a very large proportion of these cases the early diagnosis is that of localized rheumatism, and, *vice versa*, conditions giving rise to a diagnosis of localized rheumatism near the center of a long bone, or near one of the epiphyseal lines, practically always means that the patient is suffering from acute osteomyelitis. In many the disease seems to have been located by a slight traumatism. Of course, it is always necessary to bear in mind that the osteomyelitis may have existed and that the traumatism was but a coincidence.

Technique.

It is necessary only to bear in mind the pathological conditions present in order to determine the proper treatment. There is a violent circumscribed infection which, if left undisturbed, is certain to progress along the blood vessels and lymph channels and become more and more diffuse. The bone is surrounded by a tense membrane, the periosteum, and consequently the products of the infection cannot easily escape, and the pressure caused by these against the sensitive periosteum gives rise to the excruciating pain. It is plain, then, that in order to secure relief from pain conditions must be established providing for the escape of the products of infection confined within the periosteum. This may be accomplished most readily by making a long incision through all of the tissues down through the periosteum. Such treatment at once permits the septic material to escape, it relieves the pressure, stops the pain, and directs the lymph stream away from the body and therefore prevents the progress of the infection.

A number of years ago many excellent surgeons at once removed the infected bone. In some instances the entire shaft of one of the long bones was found diseased and entirely removed, and it seemed as though this was the only logical way of treating so intense an infection. However, experience has taught that in these cases in which large portions of bone in acute osteomyelitis were removed there was no reproduction of new bone to take the place of that removed, and consequently the extremity was left without bony support. On the other hand, it was found that if the periosteum was simply split open the recovery was exceedingly rapid from the acute attack, and many times a bone which seemed entirely lost regained its vitality and continued to perform its physiological functions, while in other in

stances a bone which seemed entirely destroyed regained its vitality to a great extent and it was later necessary to remove only a small portion of necrotic osseous tissue. Again, experience has taught that so long as the diseased bone was left in place there was rapidly produced between this portion and the periosteum a layer of new bone, known as the involucrum, which in a few months became strong enough to substitute the diseased bone after this was removed, and in such cases the reproduction of bone after the removal of the necrotic bone tissue progressed to such an extent that almost the entire structure was reformed. Moreover, those who have frequently operated upon osteomyelitic bone have found that even without the aid of drainage, resulting from the incision just described, almost all of these patients suffering from acute osteomyelitis recover and become chronic and that then it is possible to remove the diseased bone and still leave a perfectly useful support for the extremity in the form of the new involucrum.

In all cases of acute osteomyelitis, then, the primary operation should consist in an incision extending some distance beyond each end of the infection in the bone and must penetrate all the tissues down to the bone, including the periosteum. The drainage can be still further improved by the application of large, moist antiseptic dressings to the extremity and, of course, complete rest. A saturated solution of boric acid, or of acetate of aluminum, or a thirty per cent. solution of alcohol in hot water, are most useful fluids for this purpose. The entire extremity should be enveloped in this dressing and covered with an impervious substance like oiled silk or gutta percha tissue, or an ordinary rubber cloth. Fresh solutions should be added three to six times a day. The dressing itself need not be removed more than once every two to four days. The pain subsides almost instantly, and within a few weeks the incision usually heals, with the exception of a circumscribed point in case the bone does not entirely recuperate.

Only rarely does the surgeon see a case of osteomyelitis at the very beginning of the attack, when the infection is still confined to a limited area one or two centimeters in diameter, which can be located because of the extreme tenderness in a particular point. In these rare cases the bone should be opened with a very sharp chisel. The infected tissue should be gouged and scraped out with great care and the cavity filled with ninety-five per cent. carbolic acid for five to ten minutes, and then thoroughly washed with strong alcohol. The skin may be sutured over this directly or the cavity tamponed for a few days and then sutured secondarily.

In the event of a circumscribed portion of bone becoming necrotic it should be left in place until it has been thoroughly covered by an involucrum, developed between the necrotic bone and the periosteum. After this has become sufficiently strong to support the extremity it should be treated after the method to be described in connection with chronic osteomyelitis here following.

CHRONIC OSTEOMYELITIS.

Patients suffering from this disease most commonly give a history of acute osteomyelitis, which may have been treated after the method just described, or, more frequently, have been diagnosed as acute localized rheumatism and treated accordingly. Often the condition has progressed to the formation of an abscess, which may have ruptured spontaneously or been laid open by the surgeon. The sinus resulting from this abscess refuses to

heal entirely, or it may heal and open from time to time, the patient feeling comparatively comfortable whenever the sinus is open and suffering from pain when it is closed.

The infection may be due to one or more of the pus microbes, to the typhoid bacillus, the pneumococcus or to the bacillus of tuberculosis. If the latter form of infection exists alone the onset and the progress of the disease is usually slower than if due to any of the other micro-organisms mentioned.

The condition must be differentiated from syphilitic osteitis or periostitis. The latter is preceded by a history of syphilis or of hereditary syphilis, or there may have been syphilitic infection without any obtainable history. The progress of this condition is, however, slow; it is characterized by less acute, or rather more deep-seated, pain, which is likely to be more severe at night than during the day-time. The characteristic mark of this disease, however, is the spindle-shaped appearance of the diseased bone and the tendency to elongation and bending of the bone, in case the long bones are involved, which is not very common except in the tibia and occasionally the femur. Syphilis more commonly attacks the flat bones; tuberculosis the joints, the epiphyses and the short bones; while osteomyelitis most commonly involves the long bones.

The diagnosis of syphilitic osteitis or periostitis may be eliminated by the administration of Ehrlich's remedy 606, by the vigorous use of mercury, and by large doses of iodide of potash continued for a period of from two to six weeks. If no distinct improvement occurs the condition is probably not due to syphilis. Very rarely is there any difficulty in making a differential diagnosis between osteomyelitis and sarcoma, because in the latter there is the distinct formation of a tumor.

Operative Technique.

The treatment of chronic osteomyelitis consists in laying bare the diseased bone, reflecting the periosteum, chiseling away a sufficient amount of the involucrum to permit of the removal of the necrotic bone; then the involucrum should be chiseled away in each direction sufficiently to permit of the complete removal of all infected tissue. The granulations should be curetted away until the surface of bone is perfectly smooth and free from any of these structures. During the chiseling operation it is frequently necessary to employ great care to prevent the production of a fracture, as if the entire shaft of the bone has been necrotic the involucrum is frequently not strong enough to bear any severe strain.

In planning an operation for chronic osteomyelitis one should, if possible, arrange to leave the conditions so that a sufficient amount of the involucrum may safely be chiseled away to leave the space caused by the removal of the sequestrum entirely on one side of the bone, so that there will remain no cavity which cannot be filled by the falling in of the surrounding soft tissues. If, however, the conditions present will not permit this, the ledge of bone on one side or the other of the groove formed after the removal of the sequestrum should be chiseled parallel to the bone, remaining attached, however, to its periosteum, so that the entire ledge may be folded in against the remaining portion of the bone which is continuous above and below with the healthy structure. This prevents the formation of a cavity with unyielding walls and will facilitate healing after the operation for chronic osteomyelitis very greatly. After all of the diseased tissue has

been removed the surfaces of the bone may be swabbed with ninety-five per cent. carbolic acid, which may be left in contact for from two to five minutes, and then the cavity should be thoroughly washed with strong alcohol to remove the superfluous carbolic acid.

It has been our custom to apply strong compound tincture of iodine to these surfaces after the alcohol has been sponged away and then close the wound with sutures and apply a large antiseptic dressing, and to support the extremity by means of a splint. If, however, there is doubt about the complete removal of all the infected tissue, it is much wiser to tampon the cavity with iodoform gauze, and, if found aseptic after a few days, to close the wound by secondary sutures.

In cases operated repeatedly without permanent success, it is especially desirable to obliterate the medullary canal completely in order to leave no space to become the seat of a new infection, or that may contain a focus of old infection. This can be best accomplished by chiseling away the entire portion of bone forming the walls of the medullary canal, except on one side. It is not necessary to retain much bone, as repair will begin at once, and in a few weeks the bone will again have its normal size. It is, however, important to exercise care not to fracture the bone during the operation. The patient should be kept thoroughly under the influence of the anesthetic, as a sudden motion on his part may result in a fracture.

SEPTIC INFECTION OF THE EXTREMITIES.

Typical Case.

The patient is forty-eight years of age, works in a lumber yard, and gives the following history: His family history is negative. He suffered from the ordinary diseases of childhood; four years ago he had pneumonia, but otherwise has always been well. Four days ago he noticed a slight swelling of his left thumb, which was ascribed to the fact that two weeks ago a small sliver of wood entered at the point of the swelling. At first he paid no attention to this, but last night he suddenly began to feel exceedingly ill. The swelling extended rapidly over the entire hand, and red lines indicate the course of the superficial lymph channels along the palmar surface of the arm to the axilla. There is a very small point at which the sliver entered the end of the thumb. All the infected portions are exceedingly tender.

The patient is a strong, well nourished man. A physical examination shows his heart, lungs, kidneys and abdominal organs to be normal. His temperature at the present time is $102\frac{1}{2}^{\circ}$ F., pulse 124, respiration 20. He has the appearance of being extremely ill. During the past night he was delirious, and his friends state that his fever was very high—although the temperature was not measured.

If this patient were permitted to sit up or walk about with some small local dressing applied to his thumb, we are certain that in a few days he would develop a palmar abscess, and judging from the extension of the swelling at the present time, this would later be followed by an abscess of the forearm, and still later the axillary glands would suppurate.

Every practical surgeon has made the following observation in these patients many times, and possibly also upon himself. A slight infection of the finger occurs from a prick with a needle or from some other slight injury. During the day the finger, and even the hand, becomes painful. The

next morning the pain has entirely disappeared and the patient imagines himself well, but during the day the pain returns, perhaps a little more severe than the day before, and on the following night it again disappears, only to a less extent. After a few further repetitions a serious infection may become established, resulting in the destruction of a considerable amount of tissue, which will probably be followed by a marked impairment of the function of the extremity.

The explanation is very simple. During the day when the extremity is frequently moved the infectious material is carried from its circumscribed area to points farther up the arm. The following night this progress is again inhibited, because of the complete rest in the muscles of the arm, and there is a corresponding diminution in the symptoms. If the rest be continued the progress is permanently inhibited and the patient recovers completely. If this is not done it will ordinarily advance until he is so ill that rest is compulsory.

Treatment.

Our treatment consists in carefully cutting away the thickened skin over the point of the thumb in order to permit any infectious material still existing at the original point of entrance to escape. The great danger to the patient, however, comes from the infection which has already extended beyond the original area, and we consequently apply to the entire arm the dressing shown herewith. The patient will also receive a cathartic, preferably two ounces of castor oil in the foam of beer or malt extract, in order to remove from his alimentary canal any products of decomposition which might depress his general system. As a result of this dressing, combined with absolute rest, we will expect the temperature to be practically normal within two days, and the worst consequence that can happen lies in a circumscribed, harmless abscess that will heal within a few days after being laid open.

Even the severest infections of the extremities, such as may result from wounds received at post mortems, pin pricks or slight abrasions, nail punctures, etc., will subside within a few days if the two very simple requirements indicated above are established. The more important of these is *rest*. The septic material is carried from the original point of infection through the lymph channels. It is, however, a fact which has been repeatedly demonstrated, that this progress is very slow if the extremity remains perfectly at rest, and much more rapid if the muscles of the arm are active, because their contractions virtually pump the micro-organisms onward in the lymph channels. If a patient suffering from an infection of the hand or finger is placed completely at rest the inflammation will remain nearly stationary, even if there be no further treatment, while as soon as the patient begins to use the extremity there is a marked exacerbation of the inflammation. This we have observed a great many times.

Antiseptic Dressings.

The next important point in the treatment consists in the application of large, moist, antiseptic dressings. It does not matter whether the infection be slight or severe at first, one cannot feel certain that it will not increase in severity, and this increase in severity may be followed by very unfortunate results—such as palmar abscesses, necrosis of the tendon sheaths with the subsequent deformity and stiffness, or the axillary glands may become involved and be destroyed by suppuration, which may be fol-

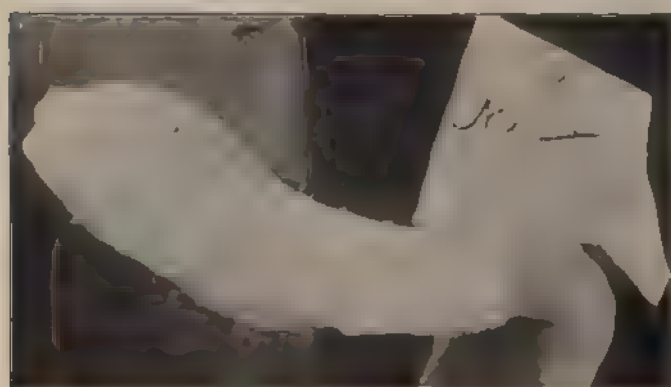
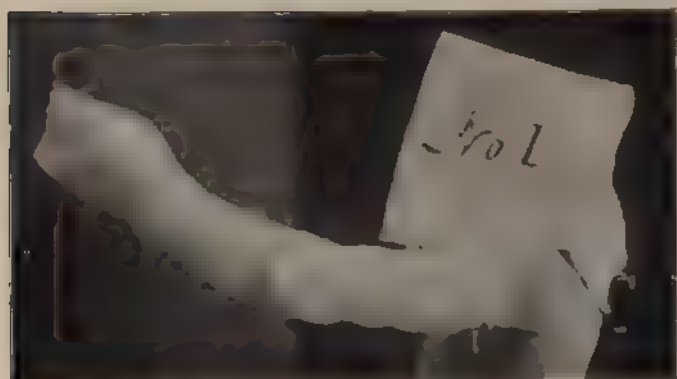


PLATE CLIV

LARGE, MOIST ANTISEPTIC DRESSING.

Each finger is first separately covered with gauze. Then the entire hand and arm to the shoulder are wound loosely with gauze, then with cotton, all being saturated with a mild antiseptic solution. The entire dressing is then covered with rubber cloth or some other impervious material. The patient should be in the recumbent position and the extremity elevated. The object of the picture is to show the extent and size of the dressing.

lowed by pyemia and death. This, however, will not be the case if the extremity is put absolutely at rest as soon as the diagnosis is made and a large, moist, antiseptic dressing is applied. Plate CLIV illustrates this dressing. It consists of five to ten yards of soft, antiseptic gauze, loosely rolled around each finger separately, then about the hand, wrist, forearm and arm to the shoulder. This is surrounded by a pound of absorbent cotton, and then by a rubber cloth, to confine the moisture and retain the temperature. Fresh antiseptic solution is poured into the dressing every one to six hours so as to keep the extremity constantly in contact with this fluid.

The dressing is renewed once in forty-eight hours and the entire extremity carefully inspected to locate circumscribed abscesses which may form, although the vast majority of these cases get perfectly well without the development of an abscess. Occasionally the circumstances may be such as to make it desirable to inspect the extremity after twenty-four hours, but usually it is better to leave the dressing undisturbed for a longer period. If an abscess has formed this is laid open, care being taken not to open into any of the surrounding healthy tissue, for that is likely to result in a progressive infection. Above all things these extremities should not be squeezed or manipulated during the dressing. We have frequently seen a patient's temperature rise several degrees, and the infection progress to a marked extent, after such manipulations. It is painful to observe a surgeon inflicting upon one of these patients what might be termed diagnostic massage, and forcing the septic material out of its fairly circumscribed and consequently relatively harmless position into the surrounding tissues.

Avoid Manipulations.

The slightest touch will suffice to indicate the presence of a circumscribed accumulation of pus, and still one frequently observes a physician *squeezing* and *crushing* these inflamed tissues for several minutes, to no purpose whatever apparently, while he is collecting his sluggish thoughts. It is well to remember that much harm may be done in this manner.

If there is a deep-seated abscess on the palmar side of the hand it may easily be located by gently pressing. There is, however, no doubt but that it is much better for the patient if these abscesses are opened a little too late than a little too early, as their contents become much less virulent from day to day and if the extremity is kept at rest there will be no progressive infection.

We have recently looked up the cases of severe infection of the fingers which we have treated in one hospital during the past two years, and find that there were forty-six during that time, and of this entire number there was not one coming without an incision of the palm or forearm whose hand was disabled as a result of the infection or the treatment; while among those who had been treated with small dressings of any kind, without absolute rest and with the palms or forearms incised before entering the hospital, deformed and stiff hands were the rule.

We have made extensive observations with a large number of these cases and have found that the patients have progressed most favorably when the following antiseptic solution was poured into the dressing every one to six hours:

Boric acid, saturated solution in water.....six parts.
Carbolic acid, five per cent. solution.....one part.
Alcohol, ninety-five per cent.....one part.

It is astonishing how rapidly a most violent, progressing infection of the extremity will be changed into a perfectly stationary, harmless affection if the two conditions mentioned are thoroughly applied.

Typical Case.

A young, vigorous farmer, about thirty hours before entering the hospital, had produced a slight injury with a dirty file while repairing some portion of an old halter. During this short time the infection had made such violent progress that the patient seemed to be in a hopeless state. He was delirious, his entire arm to the shoulder was edematous and red, his hand was severely swollen, the fingers were gangrenous and this condition had progressed upwards rapidly. Under the treatment just described, the line of demarcation formed, there was no further progress in the infection and the edema subsided rapidly. Before entering the hospital a small dressing had been applied. Until the patient became delirious he was permitted to walk about the room, which he did in the hope of reducing his suffering. As usual, the pain subsided rapidly after the form of treatment before mentioned was employed, and there was no progress of the disease, although this had been constant and very rapid previously. We have chosen this case for illustration because of its great violence.

It is doubtful whether the antiseptic solution in the dressing has much influence upon the infection directly, or whether the benefit comes entirely from the effect of the rest and the moist heat. Professor Kahlenberg has demonstrated positively, that within a few minutes after the application of moist boric acid dressings to the skin the urine shows the presence of the antiseptic, consequently it seems reasonable to suppose that there is direct benefit from the use of this remedy.

CARBUNCLE.

At this point it seems proper to discuss another localized infection so characteristic in its appearance as to be classified separately. A circumscribed area of the skin, most commonly upon the posterior surface of the neck, or upon the back, becomes indurated, then red and later purple in appearance, then a number of small perforations occur upon its surface from which a few drops of pus are discharged. The induration is usually one to five cm. in diameter, but it may extend from this focus until a large area has been included. The progress is through the subcutaneous fat. It may be uniform in every direction or extend irregularly, a larger and larger portion of the skin surrounding the original center attaining a honeycombed appearance. The infected area is exceedingly painful and the patient has the general appearance of one who is severely ill. If the disease has existed for a considerable period the center of the area will contain a circumscribed slough of connective tissue saturated with pus opposite each one of the small perforations in the skin. Unless vigorous treatment is instituted the disease usually progresses quite rapidly and its progress is especially favored by motion in the part or by manipulation, which seem to force the infectious material into the surrounding subcutaneous connective tissue. Often resistance has been greatly reduced by the presence of diabetes. Indeed in many of these cases a carbuncle occurs only because of the diabetes, and were it not for this condition the infection which has resulted in a carbuncle would have caused but a very slight circumscribed superficial

infection which would have disappeared spontaneously very quickly, had not the tissues furnished such an excellent culture medium for the micro-organisms. In every instance it is important, therefore, to examine the urine in order to determine whether or not the patient has diabetes.

Operative Technique.

Whenever it can be done the most satisfactory form of treatment consists in making a crucial incision down to the base of the infected tissue, dissecting back the four flaps of skin thus formed and then removing all of the infected parts. The cavity thus formed is then carefully sponged with ninety-five per cent. carbolic acid and, after a minute, is tamponed with gauze saturated with strong alcohol. This dressing is renewed daily until the wound is perfectly clean, when the edges of the flaps are drawn toward each other and the space permitted to heal by granulation, or if the defect is too large it may be covered with Thiersch skin grafts.

If this radical operation cannot be performed in any given case one may usually secure a satisfactory result by employing the following method: From five to ten drops of a fifty per cent. solution of ninety-five per cent. carbolic acid in glycerine is injected into the base of the indurated area, at points two cm. apart, around the entire circumference of the carbuncle. In this manner an entire circle is made around the diseased area. It is best to use a hypodermic needle and inject from five to ten drops at each point of puncture. The fluid will cause the albumen in the pus to coagulate and ooze out of the perforations in the skin over the center of the carbuncle in the form of a white fluid. This should be sponged away with pledgets of cotton saturated with alcohol so as to prevent cauterization of the surrounding skin with the superfluous carbolic acid. In order to protect the skin against this accident it is well to cover it thoroughly with vaseline before beginning the injections. After the circle has been completed, the surface is covered with a thick layer of gauze thoroughly saturated with strong alcohol, to dilute any carbolic acid which may be discharged later. The patient is kept at rest and the carbolic acid injections may be repeated once or twice if necessary, but usually one treatment will suffice or, if it fails, the radical excision of the infected tissue should be employed. If there is marked improvement the wound is dressed with moist antiseptic dressings daily until healed.

If diabetes is present large quantities of distilled water should be given in order to eliminate the sugar as rapidly as possible, and the diet should be carefully regulated. It is important to give these patients an abundance of proper food and prevent the absorption of products of decomposition from the alimentary canal. Castor oil and mild saline laxatives are well borne.

VARICOSE VEINS OF THE LOWER EXTREMITIES.

Varicose veins in the lower extremities are accompanied by a great amount of pain to the patient, and will usually result, sooner or later, in the formation of an ulcer of the leg, because of the lack of nutrition in the circumscribed areas drained by the lower end of the saphenous veins. If both the superficial and the deep veins are varicose, there will be marked edema of the entire lower extremity, and no operative treatment is of any avail. These patients will progress most comfortably if the bed is arranged so that the lower extremities rest upon an inclined plane regularly at night. This

relieves the impaired veins of much of their burden and they have an opportunity to recuperate slightly each night. In the morning, before the extremities are lowered, well fitting elastic stockings should be applied, to support the veins. It is important that the extremities be carefully measured so that the stockings may fit accurately, and that the measurement is taken after the patient has rested in bed for a number of days with the legs elevated, so that all of the edema may have disappeared. If there is only circumscribed or superficial edema, the condition usually depends upon the incapacity of the valves in the superficial veins, namely, the external or internal saphenous, or both. In this event, the patient can usually obtain permanent and perfect relief if these veins are excised, especially if in addition to such excision all the superficial veins are severed transversely. This may be accomplished by making a circular incision through all of the tissues down to the deep fascia and then uniting the wound in the skin by means of sutures throughout. It is still better if the incision is carried through the skin and superficial fascia and the veins down to the deep fascia about the middle of the leg, through the circumference, with the exception of an inch opposite the spine of the tibia, and the same distance on the posterior surface of the leg. The superficial fascia and veins between the skin and the deep fascia at these points may be severed by passing a knife under the skin with the cutting edge downward. This will prevent a circular scar extending entirely around the leg. A further improvement in this operation consists in making the incision obliquely instead of exactly at right angles with the leg. The operation is performed with a constrictor applied to the thigh, so there can be no hemorrhage during the operation, and it will not be necessary to ligate any of the veins, the constrictor not being removed until the dressing has been applied and the patient placed in bed, with the extremity elevated.

EXCISION OF THE SAPHENOUS VEINS.

The internal saphenous vein is more commonly affected than the external. To determine the extent of the excision the patient should be permitted to stand erect for a few minutes and the point noted to which the vein is enlarged. It should then be excised to a distance several inches above this point.

Technique.

The extremity is elevated and held for several minutes until the veins have become entirely empty. Then an Esmarch constrictor is applied to the thigh high up and the vein laid bare by an incision extending over the entire distance through which it is enlarged. The uppermost end is then dissected free, grasped with two pairs of hemostatic forceps and cut between, and the upper end ligated. The vein is then dissected out downward throughout the desired length; the larger communicating branches being caught with forceps and ligated, or they may be left open with safety. After the entire vein has been excised the wound is closed and a large antiseptic dressing applied, so that the pressure upon the wound will be uniform and mild. The constrictor is not removed until the patient has been placed in bed with the extremity elevated. The extremity should be left in an elevated position for at least one week after the operation, and then it should be slowly lowered. At the end of the second week a soft flannel bandage may be applied and the patient permitted to be about. It is well for the patient to wear a flannel

bandage, applied every morning before the foot is lowered, for a number of months. It is also wise for him to sleep with the extremity elevated upon an inclined plane so as to relieve the deep veins during the night.

Unnas' Paste Cast.

In mild cases of varicose veins of the extremities the following treatment, if applied for a period of from three months to one year, will almost always give great relief, and it will frequently strengthen the veins to such an extent that the patient may remain entirely well for years.

The limb should first be kept in an elevated position for several days and nights in order to empty the veins thoroughly and remove any edema that may be present. The following mixture is then prepared. Place four parts by weight of plate gelatin in ten parts of distilled water, permit this to stand over night, then place in a water bath, heat in this way, stir constantly until dissolved; add ten parts of glycerine while hot, then add four parts of impalpable oxide of zinc powder. Stir constantly.

Apply ten thicknesses of gauze about the foot, covering the toes to protect them against contact with the cast. Apply a similar amount of gauze around the upper end of the proposed cast.

If this precaution is not taken the skin will be severely irritated at the upper and lower ends of the cast. It is consequently also important not to apply any of the paste beyond the margin of these protecting gauze bands. The surface of the foot and leg between these two bands is now thickly painted with the hot paste by means of an ordinary large painter's brush. The surface is then covered with a thin gauze roller bandage two inches wide, great care being taken to apply the bandage smoothly. These bandages are now continuously covered with the hot paste until the leg has been covered with about four layers of the saturated gauze roller bandages. The cast remains elastic after it is dry. It may be worn from one to four months, when it should be replaced.

The same method is indicated in the after-treatment of cases that have been operated for the relief of varicose veins, or varicose ulcer.

VARICOSE ULCERS.

If the veins have been varicose for quite a time, especially in patients working hard, or in those who are likely to subject their extremities to traumatism, an ulcer is apt to form on the lower extremity. So long as the patient remains upon his feet, and so long as nothing is done to relieve the condition in the veins, such an ulcer is unlikely to improve. If, on the other hand, the patient is placed in bed with the lower extremities elevated upon an inclined plane, the pressure removed from the veins and consequently the return circulation favored, the area occupied by the ulcer becomes better nourished and healing is promptly favored. The same is true after excision of the varicose veins, and the circular incision through all of the superficial veins, provided the ulcer has not existed too long and has not become of such size that its covering with epithelium is impossible. The floor of the ulcer will then become composed of a mass of hard, connective tissue, the result of an attempt at cicatrization of the ulcer, and it is difficult for epidermis to grow over this surface.

In these advanced cases it is better to excise this connective tissue and cover the entire surface with Thiersch's skin grafts, at the same time that operation is performed for the relief of varicose veins. By the time the

wound of the latter operation is healed the skin grafts will have firmly adhered to the raw surface and the patient at once relieved of the ulcer

SKIN GRAFTING.

This operation is indicated wherever a surface is deprived of a sufficient amount of skin to make a spontaneous covering impossible, or in cases in which it would require too great a period of time, or in which the skin formed in this manner would not be sufficiently substantial. It is also indicated after the removal of tumors in which so much of the overlying skin has to be removed as to make it impossible to bring the edges properly together. In these instances the operation of skin-grafting may be carried out at once, provided the hemorrhage be sufficiently stopped at the time of the operation. The same is true after the excision of troublesome scars after burns or injuries.

Technique.

The success of the operation depends upon,

1. Absolutely aseptic conditions.
2. Securing a bloodless surface on which to graft the skin.
3. The accurate application of the skin grafts; and
4. The fact that the grafts have not been injured by contact with any antiseptic solution between the time of their removal from the normal skin and that of their application to the raw surface.

The area from which the skin is to be removed should be prepared as carefully as though any other operation were to be done. The most convenient place from which to obtain skin is the outer surface of the thigh. The skin is removed by means of a sharp razor, preferably with a wide blade, held parallel with the surface of the extremity, being permitted to slide upon the thigh. The thickness of skin to be removed is regulated carefully by the method of holding the razor. The skin should be stretched so as to make it as tense as possible. Then a layer should be shaved off by means of a sawing motion. This layer should contain the epidermis and a thin portion containing the tops of the papillæ.

The portion cut is permitted to fold itself upon the surface of the razor until a sufficiently long strip has been removed to extend across the ulcer to be covered. This may be calculated very easily, so that each successive strip will extend quite across the ulcer. Neither the skin nor razor, nor the surface to be grafted upon, should be wet. If this precaution is taken union between the surfaces will take place almost instantly.

The plan practised so long of covering the razor, the skin and the portion to be grafted with normal salt solution reduces the chances of rapid and perfect union.

In order to spread the graft over the area to be covered most conveniently the sharp edge of the razor should be placed in contact with this surface, and while the graft is being pulled off this edge by means of a needle fastened in a pair of hemostatic forceps the razor is slowly moved across the surface. In such manner the graft will be almost perfectly spread without any further manipulation. The edges may be still further adjusted by means of a pair of needles fastened in hemostatic forceps. It is well to let the delicate edges of these grafts overlap a little. After the entire surface has been covered with a series of these sections it is protected by the applica-

tion of a network of rubber adhesive strips from two to three millimeters in width. These will at once protect the underlying skin grafts and at the same time make it possible for drainage to take place between these pieces. A dressing of sterilized gauze is placed over these strips and held in position by means of rubber adhesive straps. A thick layer of absorbent cotton is then put over all and held in position by means of a soft roller bandage.

After-treatment.

The wound is not disturbed for one week, when the dressings are thoroughly moistened and removed without disturbing the grafts. It is important that the dressings be not pulled upon as at this time the attachment between the grafts and the raw surface is still very slight. If the dressing is performed carelessly enough harm may be done to destroy a portion of the new skin.

After the dressing has been removed, together with the rubber protective strips, a similar toilet to the one first applied should be used and at the end of a second week, when this is again removed, the wound is usually found perfectly healed. If this plan is carried out it will not be possible to distinguish, after the wound has healed, the different grafts applied; the surface being perfectly smooth, there will be no traction thereon, and it will be sufficiently firm to bear the ordinary abuses to which the skin is exposed.

NERVE SUTURES.

Nerve suturing should be employed where a nerve is severed accidentally during an operation, where a portion of nerve had to be excised together with some malignant growth, where a portion of nerve has been severed or destroyed by traumatism, and occasionally in cases in which a nerve has been caught between the ends of a fractured bone and destroyed by the pressure due to the formation of callus.

If the nerve be sutured immediately after being severed the operation simply consists in adjusting the nerve ends and then applying a sufficient number of fine catgut sutures to hold them in perfect coaptation. It does not matter whether these sutures are passed through the trunk of the nerve or simply include the sheath. The important point is to have the ends of the nerve carefully approximated. It is well to adjust over the line of suture in the nerve a convenient piece of fascia, which can be obtained in the wound by means of a few fine catgut sutures.

If a portion of nerve has been destroyed by some traumatism the difficulty is easily managed, as one of the principal conditions to be obtained in order to secure success is the absence of tension upon the nerve ends. In cases in which the ends cannot be adjusted absolutely without tension the distance between them should be bridged over in the following manner:

Technique.

The nerve ends are cut off squarely; then a very fine cat-gut suture is passed back and forth between the divided extremities, each time passing through the end at a little distance from the previous point of perforation until a bundle of catgut has been produced approximately the size of the nerve being sutured. This should be applied so that there is absolutely no tension upon the sutures, which should lie loose between the two nerve ends. When a sufficient amount of this catgut has been thus arranged the ends

are tied and the entire bundle of catgut, together with the two nerve ends is covered by reflecting a flap of fascia over them and attaching them in some of the soft tissues beyond by means of a few fine catgut sutures. By this method we have secured perfect functional results where as much as three inches of the ulnar nerve had been destroyed by a gunshot wound, and in a number of other cases we have had equally satisfactory results with this form of grafting nerves by means of intervening catgut suture. If the nerve has been severed for a period of time the conditions are still further complicated because the ends of the nerves are now covered with connective tissue, and in order to secure satisfactory functional results it will be necessary to absolutely remove all of this connective tissue. The tendency in these operations is always to cut away too little of such tissue in order not to increase the distance between the ends too greatly. Many failures are undoubtedly due to this disposition.

With section through a relatively healthy nerve and a distance of an inch or more between the ends the chances for a satisfactory functional result are much greater than with the ends directly sutured together, and wherein all of the connective tissue which has resulted from the healing of the nerve stump has not been removed.

We would, therefore, emphasize the importance of cutting away a sufficient amount in cases in which nerve grafting is practised a considerable time after the nerve has been severed. Here again it is important to bear in mind that a condition of tension is the worst possible one to be obtained in nerve suturing.

The surgeon will often encounter no small amount of difficulty in finding the nerve ends directly, if the operation is performed some time after the injury has occurred, for the traumatism itself and the subsequent healing has usually disturbed the relations to such an extent that the nerve cannot readily be discovered by searching for it in its normal anatomical position.

The proximal nerve end is usually considerably enlarged and may therefore, be found more easily, as it can be felt through the other tissues. This is not the case with the distal nerve end, however, which is rarely enlarged at all. It is always wise in these cases, if the nerve end is not found at once, to locate the nerve in its normal position at some distance from the point of injury and then follow it down to where it has been severed. It is not necessary to loosen the nerve entirely from its attachments in doing this. All that needs to be done is to free its superficial surface and follow this down to the end.

If the nerve has been included in callus, resulting in a paralysis of the portion beyond the seat of the fracture, and was not injured directly at the time of the fracture, then the paralysis will have come on slowly and not have existed directly after the time of the injury. For this reason it is important to obtain a perfect history, for it frequently happens that a nerve is surrounded by callus, and as this increases in firmness the pressure upon the nerve results in a paralysis. If this nerve is laid bare and the callus chiseled away the nerve may be released from its grasp, and unless it has been held in the callus for a lengthened period its function will be restored. In order to prevent from again becoming compressed in the callus it should be carried to some distance from the original point of incarceration and surrounded by some of the soft tissues. The same precaution should be taken in case the nerve has been entirely severed and the ends caught in the callus.

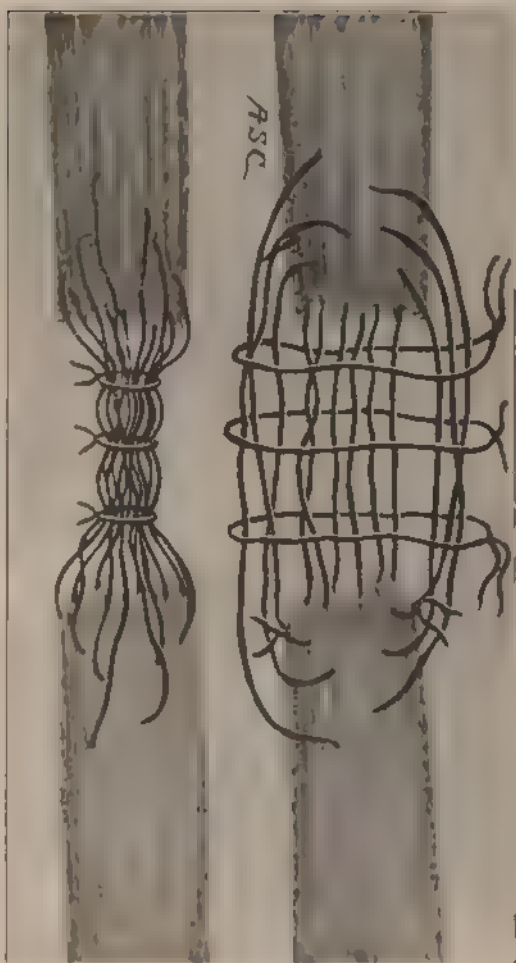


PLATE CLV.

NERVE SUTURE.

a—distance. To the left the loose catgut sutures are shown, indicating the great importance of avoiding all tension. To the right the loose catgut sutures have been gathered into a bundle by tying the circular catgut ligatures loosely.

Too much stress cannot be laid upon the importance of carefully observing cases of paralysis following fracture, as much greater success follows an early than a late operation.

Prognosis.

Where the nerve is sutured directly at the time of the injury, both the immediate and the remote results are good. Sensation may return within a few hours after the operation, and motion will begin to return within a few weeks, and may be perfect within three months. If the operation be performed several weeks or months after the injury, then sensation may return within a short time, but unless the action of the muscles is maintained by means of electricity or massage atrophy is likely to occur and the patient will recover but slowly from the paralysis of motion. In some instances the recovery from paralysis of motion may occur as late as one or two years after the operation, and the functional result may continue to improve for a very long time thereafter. The prognosis is relatively much better the nearer the terminal end of the nerve the injury occurs; consequently the suturing of one of the large nerves does not give nearly so good a prognosis as the smaller ones. During the past few years considerable progress has been made in transplanting nerves, or portions of nerves, to supply other nerves which have lost a portion of their substance as the result of traumatism or operation. This plan has recently been extended to the transplanting of a portion of a normal nerve into the edge of a nerve which has become useless as the result of central disturbance, such as poliomyelitis. It is claimed that in this manner the portion of the nerve which remains intact will carry on the function of the entire nerve, while the portion attached to useless nerve will in time restore the latter to a fair amount of activity.

We are not, as yet, prepared to judge the value of this method.

TENDON SUTURES.

If a tendon is severed and sutured immediately the result is almost invariably satisfactory, provided the wound remains aseptic. It does not matter what method of suturing be employed so long as the tendon ends are in apposition. It is, however, best to insert the sutures in such a manner that they cannot readily split the tendon end longitudinally. This is best accomplished by passing the suture into the tendon end, then out through one side, then passing it a short distance across the tendon, and then into the tendon again.

If a considerable portion of a tendon has been destroyed the ends may be united in the manner described for uniting nerve ends at a distance. The functional results in these cases are surprisingly good. We have repeatedly united tendon ends more than six inches apart with perfect functional results where theoretically one could expect nothing but failure. It is, however, of the greatest importance to avoid tension.

In cases in which a tendon is contracted it may be lengthened by splitting longitudinally in halves, then cutting off one of these segments in one direction at the end of this longitudinal incision and the other segment in the opposite direction at the other end, then stretching out the tendon and uniting the two segments so produced. In this way any desired amount, which does not exceed double the original length, may be very easily obtained. The tendon very quickly becomes firm and the functional results are highly satisfactory.

If the operation is performed immediately after a tendon has been severed the greatest difficulty is encountered in finding the tendon ends, which usually retract a greater or less distance within their sheaths. If a closed pair of forceps be passed up through the sheath until it reaches the point at which the tendon end can be felt and then opened, this end can usually be caught and brought down. In case this cannot be done an incision may be made opposite the point to which the tendon has retracted and a stitch may be passed through the tendon end and threaded in the eye of an old-fashioned probe, and this carried through the sheath of the tendon, and then by drawing on the suture the tendon end may be brought down and united to the distal end. If the end cannot be located the sheath may be split until it is reached. It is then brought down and united and the sheath sutured over it with fine catgut sutures. Usually this does not result in any adhesions between the sheath and the tendon unless the wound becomes infected.

In applying sutures to tendons tension should be avoided and the sutures should never be tied tightly enough to cause pressure necrosis, as tendon is a tissue not well supplied with blood, and consequently easily injured in this manner.

Healing may be further favored in applying the dressing with the extremity in the most favorable position for obtaining a relaxation of the muscles belonging to the tendons which have been sutured.

TENDON TRANSPLANTATION.

In patients suffering from infantile or spastic paralysis it is often possible to obtain remarkably satisfactory functional results by transplanting the tendon of a muscle not affected by the paralysis to the insertion of a tendon of a muscle which is affected. This may be best illustrated in talipes varus in infantile paralysis, but the same principle applies elsewhere.

Here the equinus position may be overcome by lengthening the tendo achilles, while the deformity due to turning in of the foot is corrected by transplanting the lower attachment of the tendon of the tibialis anticus muscle from the inner to the outer side of the foot. An incision 2 cm. in length is made just below the anterior annular ligament of the ankle, directly over the tendon of the tibialis anticus muscle. A blunt hook is passed around this for the purpose of making traction. Then a similar incision is made over the attachment of the tendon to the inner surface of the cuneiform bone. The tendon is then loosened from its lower attachment, which may be facilitated by drawing gently upon the blunt hook. A third incision is then made over the point of insertion of the peroneus brevis to the outer surface of the fifth metatarsal bone. The space between the first and the third incisions is then tunneled with a pair of blunt forceps, and the end of the tendon drawn through this channel and carefully attached to the tendon of the peroneus longus by means of fine chromicized catgut sutures near the point of attachment of the latter muscle, or to the point of attachment of the peroneus brevis. The three wounds are then sutured and the foot dressed in a plaster of Paris cast at a little less than a right angle. The splint is worn for three months. In our experience this operation has given very satisfactory results.

It is, of course, important that the muscle to which tendon is to be transplanted be in a fairly normal functional condition.

It is unnecessary to carry the application of this principle through the

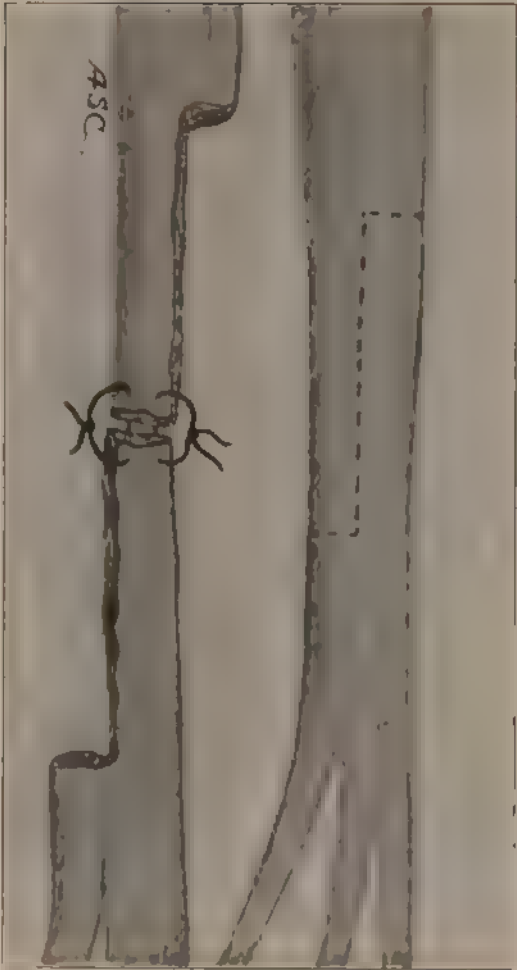


PLATE CLVI

OPERATION FOR LENGTHENING CONTRACTED TENDONS

To the left is shown the incision, which may be lengthened to any desired extent To the right is shown the method of suturing the lengthened tendon

various operations in which it may be employed as any one sufficiently familiar with anatomy may select from the muscles those best suited for the purpose of substitution for those which are completely or partly paralyzed.

TUBERCULOSIS OF THE JOINTS.

This condition is characterized by its slow beginning, by its usual limitation to one joint, by the tendency to fixation of the joint, and, later, by atrophy of the muscles, both above and below the affected part. Its location is often determined by a traumatism, although this cannot always be established, and where there is a history of injury the surgeon cannot always exclude the possibility of coincidence.

Usually it is secondary to tuberculosis of the respiratory or alimentary tract, the tonsils or the lymph glands, the bacilli having been carried to the vicinity of the epiphyseal line of the bones or to the joint surfaces by the blood-stream. It is therefore of the greatest importance that the surgeon's attention be primarily directed toward the improvement of the patient's general health, which can be best accomplished by bettering his hygienic surroundings, nutrition and habits of life; and by administering tonics and concentrated foods and some form of creosote. Above all things he should not be permitted to continue living under the conditions which primarily gave rise to his disease. These points are of great importance, not only in obtaining a recovery from the immediate disease, but also for the purpose of securing permanency of cure. It is virtually always necessary to change the dwelling of these patients, if not the climate; to change their food, regulate their hours of rest, and frequently their occupations. This having been done, the treatment of the joint involved will depend upon its location and the extent to which the disease has progressed; but in any case as nearly complete rest as possible for the joint is most to be desired, especially if this can be obtained without confining the patient to bed. If the disease is in an incipient stage, rest alone, with the conditions described above, will usually suffice to produce a recovery.

A light cast made of plaster of Paris, very carefully constructed, and strengthened by the incorporation of thin strips of tough wood, such as are used in the manufacture of market baskets, is usually the most desirable dressing, unless the patient can afford a similar dressing manufactured of aluminum. The cast should be applied over some elastic woven material, arranged in a double layer, so that any friction will not be directly against the skin, but against the second layer, which will remain free.

If the ankle or the knee joint is involved, it is best to draw two closely fitting stockings over the extremity.

The cast should be worn for a number of months after the joint is apparently perfectly well.

HIP JOINT TUBERCULOSIS.

In the hip joint the treatment by fixation with a plaster of Paris cast should be supplemented by weight-and-pulley extension, to be applied at night, for a period of at least two years after the joint has apparently fully recovered, as this seems to prevent recurrence, deformity, to increase the comfort of these patients, and to remind them of the necessity of avoiding traumatism for a considerable time. The extension is made by applying a strip of rubber adhesive plaster from eight to twelve centimeters in width,

to the inner, and outer surface of the entire thigh and leg, and holding them in place by a roller bandage. These plaster strips are attached to the cord which passes over the pulley to the weight, by means of two cords attached to a cross-piece of wood eight to fifteen centimeters in length. The lower end of the bed should be elevated from ten to twenty centimeters, in order to secure counter-extension from the weight of the body. The weight employed should be from one-tenth to one fifth of the weight of the body, the correct amount being determined by the comfort of the patient. It is well to begin with a light weight and increase gradually.

If rest and hygienic measures alone are not sufficient to obtain a cure, which may usually be determined by an increase in the pain, or that the swelling does not subside, or that a point of fluctuation appears in the vicinity of the joint, then it will become necessary to open the joint and remove the diseased tissues, consisting of portions of the capsule, the synovial membrane and cartilage of the joint, and in advanced cases usually some portion of bone.

Often the radical operation may be postponed until the treatment by means of injection with a mixture of iodoform and glycerine has been tried. This will be described presently.

Technique.

In children, the least possible amount of tissue should be removed, as in a great majority of cases this will suffice to produce a cure quite as frequently as a more extensive operation, and because the less tissue removed the less will be the deformity, and likelihood of impairment in the future growth of the extremity.

In adults conditions are somewhat different. Here an excision of a sufficient amount of bone to insure ankylosis is much more likely to cause a satisfactory outcome, especially in the hip and knee joints, both as regards permanency of cure and preservation of function.

The ankylosis favors strength and the absence of motion gives freedom from pain. The permanency of cure depends to no small degree upon the fact that any slight focus of infection which may have been overlooked is much less likely to be kindled into activity if the joint is placed perfectly at rest by the ankylosis. Moreover, the excision of a sufficient amount of bone to secure this condition increases the likelihood of a complete removal of all the diseased tissue. After the diseased tissue has been completely removed, the raw surfaces should all be thoroughly and repeatedly swabbed with a ninety-five per cent. solution of carbolic acid for a period of five minutes, the superfluous acid being washed away with strong alcohol. After this, it is well to apply strong compound tincture of iodine to the entire surface, and then a ten per cent. solution of iodoform and glycerine, after which the wound is to be closed with deep sutures of catgut and superficial sutures of any desired material. If any doubt exists as to the aseptic state of the joint when the operation has been completed, it should be freely drained with rubber tubes or with iodoform gauze passed transversely through the articulation. The joint is then covered with a large dressing and immobilized by plaster of Paris or splints.

All the joints of the upper and lower extremities, with the exception of the shoulder and the hip joint, are operated after the application of an Es-march constrictor. This facilitates the work greatly and it is an easy matter to avoid all the important blood vessels during the operation, hence it is not necessary to remove the constrictor before suturing the wound and ap-

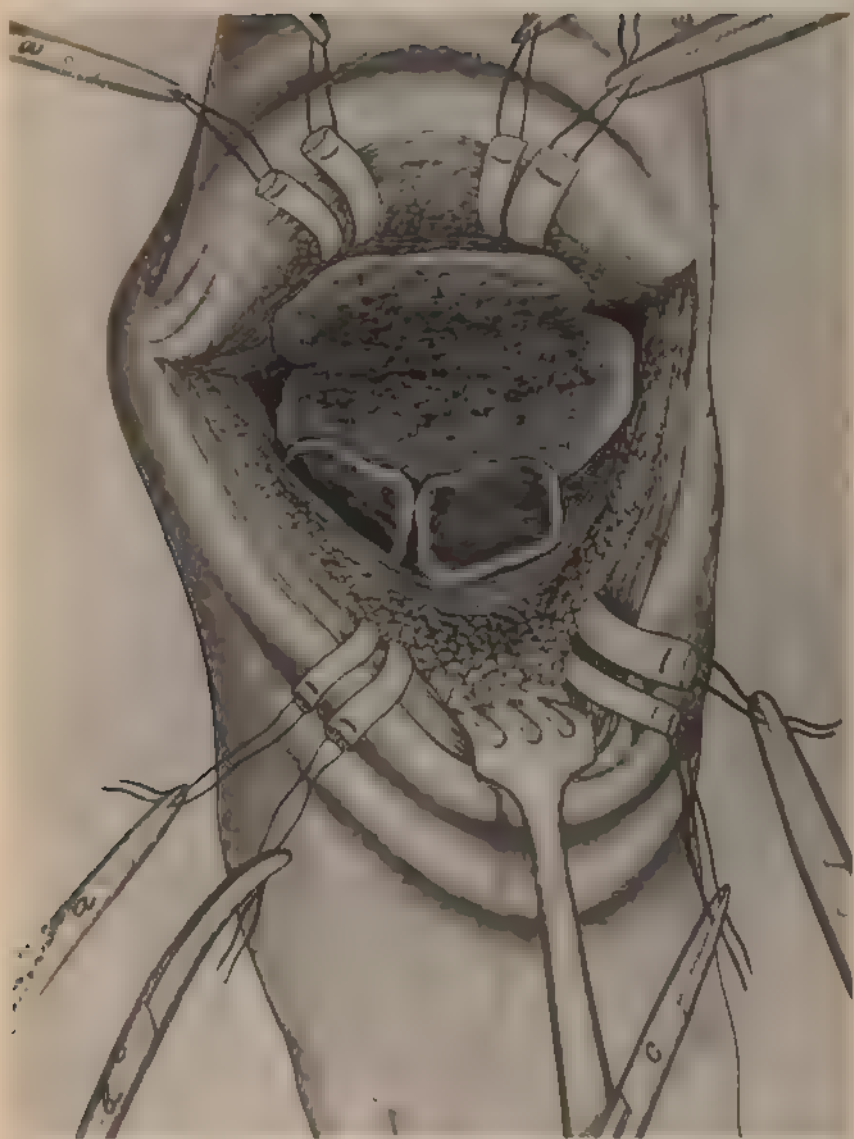


PLATE CLVII

EMCISION OF ANKLE WITH TRANSVERSE ANTERIOR INCISION

Similar forceps being placed upon sutures inserted in the two free ends of each cut tendon for identification

plying the dressing. If, however, there is any fear in the mind of the operator of hemorrhage later, it is always best to remove the constrictor before suturing the wound, carefully grasp all bleeding joints with artery forceps and ligate them before closing the wound.

RESECTION OF THE ANKLE JOINT.

Nothing has been said concerning the operation itself in connection with each joint, because the typical operations outlined in every text-book are quite as satisfactory as any we may describe, with the exception of the method for resection of the ankle joint. The operation which is here outlined is not generally practised, but any surgeon who has once tried this mode will always continue to employ it, as it insures a most satisfactory approach to the diseased tissues, and the results are likewise most satisfactory, both as regards the functional effects and permanency of cure. This is true even in cases that seem quite hopeless with any other method.

Technique.

An incision is carried directly across the anterior surface of the ankle from malleolus to malleolus through the skin, superficial and deep fascia and the sheaths of all of the tendons in the course of the wound. Externally the peroneal artery and nerve should be avoided, as well as the tendons of the peroneal muscles, which may readily be drawn out of the way. Internally the posterior artery and nerve should be protected. Each tendon is then lifted up in the incision and transfixed with two fine catgut sutures from one to two centimeters apart. These sutures are caught in similar artery forceps for purposes of identification, then the tendon is cut transversely between these sutures. After all the tendons have been disposed of in like manner, the joint is opened by a free transverse incision and the sole of the foot forced back upon the calf of the leg. In this manner the entire joint is opened freely, so that all diseased tissue may be removed. After this has been accomplished, as described in connection with the treatment of tuberculous joints in general, the foot is placed in position, the tendons carefully adjusted, which may be done with great ease, because the two sutures upon two corresponding tendon ends are fastened to hemostatic forceps of the same pattern. Each tendon is carefully sutured and a fine stitch placed in the fascia to cover the line of suture in the tendon. Then the skin is sutured over all. If drainage seems necessary, it is applied through and through, and even in cases apparently requiring no drainage, we have usually passed a few strands of catgut or silkworm gut entirely across the foot, permitting the ends to protrude from the lower angles of the wound so as to drain the serum which may be secreted by the large surface during the first few days. A large dressing is applied and the foot immobilized in a position at a little less than a right angle.

After-treatment.

The foot is elevated in order to favor return circulation. If drainage has been used, this is left in place from one to two weeks. The dressing is not changed, unless indicated by the discharge, for a week or ten days, in order to avoid moving the foot, and after that as seldom as possible for the same reason.

Prognosis.

The prognosis is very good after this operation. The free exposure of

the surfaces insures thoroughness, and consequently the cure is usually permanent. The ankylosis of the surfaces immediately in the field of operation does not interfere with movement because the tarso-metatarsal joints will supply the motion necessary. The tendons unite readily and act normally. There is no operation for the relief of joint tuberculosis that has given us more satisfaction than this. With this method it is often possible to obtain a useful foot in cases which formerly could only be relieved by an amputation.

At the present time it is possible to obtain artificial limbs, in case of amputation at the lower third of the leg, so excellent that unless one can secure a good result after a resection of the ankle an amputation is to be preferred.

TUBERCULOSIS OF THE SHOULDER, ELBOW AND OTHER LARGE JOINTS.

The shoulder joint deserves some special attention, as it is least useful when ankylosed, and consequently an operation for the relief of tuberculosis must here be performed in a manner that will prevent ankylosis. This may be accomplished by stripping back the periosteum upon the shaft of the bone, then cutting away the head, together with two or three centimeters of the shaft and afterwards covering the end of the bone with the periosteum, which has been stripped back, together with some fascia.

The Elbow Joint.

In the treatment of tuberculosis of the *elbow joint*, the social and economical condition of the patient must be considered. An ankylosis at a little less than a right angle will produce the most useful and the most powerful arm for a laboring man or a mechanic, but the awkward position will interfere with the patient's appearance. If one desires the greatest amount of power and usefulness, the arm should be dressed at a little less than a right angle. If he is willing or desirous to sacrifice these qualities for the sake of obtaining greater beauty, a sufficient amount of bone should be removed to insure a movable joint, the ends of the bones being again covered with soft tissues.

The *wrist joint* should be dressed as nearly straight as possible.

The Hip Joint.

The *hip* should be dressed with the extremity in the abducted position, the foot extending as nearly straightforward as possible, both inversion and eversion being avoided. This precaution considerably overcomes the tendency to shortening. This position may be secured by means of a plaster of Paris dressing, or by a weight-and-pulley extension, combined with the use of a Hodgen's splint with a foot-piece attachment, which will insure the vertical position of the foot.

The *knee* should be dressed in a slightly flexed position, because this secures the greatest ease in walking.

TUBERCULOSIS OF THE SACRO-ILIAC JOINT.

Tuberculosis in this joint is characterized by lameness, which at first is apparent only during, or more frequently the day after, severe exertion.

A misstep or a quick motion is likely to give rise to pain. The patient

usually at first imagines the pain to be located in the hip, and percussion over the great trochanter is apt to give rise to pain. There is, however, no suffering upon motion of the hip, flexion, extension and rotation being normal and painless, unless the motion is very sudden and sufficiently violent to affect the ilium. There is no pain upon pressure over the hip joint, but pain is present when pressure is made over the sacro-iliac articulation, or when compression of the pelvis is made. There is frequently an evening temperature.

Technique.

The same principles obtain here in the treatment of tuberculosis as in the other joints. In many hygienic measures and rest will result in a cure. Injection with iodoform emulsion gives very favorable results, and should a sinus be formed, cauterization frequently produces a cure. It is rather more difficult to obtain a thorough removal of all the diseased tissue where the joint is extensively involved and in which the measures mentioned above have failed to produce a cure, than in tuberculosis of other joints.

In these cases it becomes necessary to avoid injuring the sciatic nerve if the bone is so extensively diseased as to approach this structure. Our own results have been best when we have thoroughly removed all of the diseased bone, then treated the cavity with strong carbolic acid, then with alcohol and then tamponed with iodoform gauze, which was removed after a week, when the cavity was treated with strong tincture of iodine and sutured secondarily.

The patient should be kept in bed until the tissues have become firm, because motion is likely to disturb the newly-formed tissues and cause a recurrence.

After-treatment in Cases that do not Heal Primarily.

Should the wound not heal primarily, the sinuses may be stimulated by the injection of strong compound tincture of iodine, ninety-five per cent. carbolic acid, followed with strong alcohol, or two to ten per cent. solutions of nitrate of silver in water.

It has been claimed that these sinuses will heal much more rapidly if exposed daily to the influence of the X-ray for a period of fifteen minutes at a distance of twelve to fifteen centimeters. We have not tried this method in a sufficient number of cases to be entitled to an opinion, as the possibility of coincidence must not be overlooked.

In a number of instances we have seen rapid and permanent healing after touching these sinuses thoroughly with the actual cautery, the point of the cautery being introduced into the sinus, permitting the heat to radiate to the surrounding tissues. This is much better than to attempt to touch all of the infected parts directly. A rod of iron the size of a lead-pencil, heated to red heat in a gas or alcohol flame, or in a coal fire, or a tinsmith's heater, serves this purpose admirably. Before introducing this rod into a sinus, the direction and depth of the latter should always be determined by means of a probe, in order that the cautery may be readily introduced in a manner to insure the cauterization of the sinus throughout its course without destroying healthy tissue.

MIXED INFECTION IN TUBERCULOUS BONE AND JOINT DISEASES.

So long as the entire infection is due to the bacillus of tuberculosis, the

progress of the disease is slow, and except where the pressure within the capsule of the joint gives rise to severe pain, the patient usually does not give the impression of being very ill, unless the affection is complicated with other troubles, such as tuberculosis of the lungs. If, however, the disease becomes complicated by infection of the abscess with other pathogenic micro-organisms, the condition of the patient at once becomes much more serious. He acquires the appearance of one suffering from a degree of sepsis, depending upon the form and extent of the infection, and his general state becomes rapidly more grave, usually first recognized by the characteristic hectic flush.

It is a singular fact which has been constantly demonstrated clinically, that a tuberculous abscess may open spontaneously and discharge through a sinus for weeks, months, or even years, without becoming infected with other pathogenic micro-organisms, while a similar abscess opened by an incision may become infected almost at once. This is of great practical importance, as it illustrates the point that by a simple incision the surgeon may in a moment change a harmless tuberculous abscess into an exceedingly harmful mixed infection.

In any case, then, in which it seems impossible to remove all the tuberculous infection and change a tuberculous abscess into a clean wound, it seems important to follow a method which removes the tuberculous pus from the body without substituting for it a worse condition. This may be accomplished by lifting up a fold of the adjoining healthy skin for a distance of three to five centimeters and piercing the abscess with a trocar two or three millimeters in diameter, permitting the tuberculous pus to escape, and then injecting the cavity with a ten per cent. solution of iodoform in glycerine, sterilized. (The iodoform should be put into an open bottle with a cotton stopper, and placed in a water bath. The water should be permitted to boil around the bottle for one hour. This will liberate enough free iodine to accomplish the sterilization).

IODOFORM-GLYCERINE INJECTION OF TUBERCULOUS JOINTS.

There is much difference of opinion regarding the value of iodoform-glycerine mixtures injected into the cavity of tuberculous joints. Its advocates show a large number of perfect and permanent recoveries following this form of treatment, while its opponents claim that all of these cases belong to a class which would have healed with the same results in about the same time had they been treated with rest and ordinary hygienic measures. Both the advocates and the opponents of this form of treatment represent some of the ablest and most experienced surgeons, and we are not prepared to decide which faction is right, although our own experience is strongly in favor of this method in the early treatment of tuberculosis in all joints, except the hip. There are, however, several points in the technique which should be rigorously obeyed:

1. The trocar should never be plunged directly into a joint, but always obliquely underneath a fold of skin, so that a valve will be formed when the instrument is withdrawn, which will prevent the infection of the joint cavity with pathogenic micro-organisms.
2. The amount of manipulation should be limited so as to prevent the opening of lymph spaces through which secondary infection might occur.

3. The amount of pressure employed in injecting the solution should be moderate in order to avoid rupturing the capsule of the joint and forcing the fluid, together with tuberculous contents of the joint, into the tissues surrounding.

4. If the treatment does not result in distinct benefit to the patient after five or six applications, from one to two weeks apart, it should be abandoned.

5. The patient's general and hygienic surroundings must be improved to a favorable standard.

6. As much as possible of the fluid contained in the joint should be withdrawn before the injection is made.

7. Except in the shoulder and sacro-iliac joints, an Esmarch constrictor should be applied before the joint is tapped, and left in place until a large dressing has been fitted and held in position by a snug bandage, which will prevent hemorrhage into the joint.

This last precaution is not generally employed, but we are confident that it is of distinct benefit.

In applying the constrictor for this purpose the same precaution should be taken against injuring the large nerves as in other operations. A large rubber tube or a broad rubber bandage should be used in preference to the narrow rubber band usually employed. If a small rubber tube or a narrow band is used, the extremity should first be protected by wrapping with a towel, folded upon itself at least four times.

In inserting the trocar into the various joints, aside from carefully securing a valve formation of the canal, the surgeon must avoid injuring important anatomic structures in the vicinity of the joint, and the point of the trocar must be directed so that it will not injure any joint surface.

In the smaller joints a very small amount of the solution may suffice, the quantity depending upon the tension caused by the fluid injected, which should never be sufficiently great to endanger the capsule or produce severe pain. In the wrist joint the introduction of the fine trocar used is usually not followed by the evacuation of any fluid, and here the injection of two to four cubic centimeters will often be followed by perfect results.

In the knee joint it is often possible to withdraw several ounces of fluid, and in these cases it is safe to inject as high as thirty or forty cubic centimeters of the iodoform-glycerine solution.

In the treatment of psoas and iliac abscesses much larger quantities of tuberculous pus are frequently withdrawn through the trocar, and it is safe to inject from thirty to fifty cubic centimeters of a ten per cent. solution of iodoform in glycerine.

To prevent too great tension in injecting this solution into tuberculous joints, it is well to attach a soft rubber tube to the trocar with one end, and to a glass syringe holding thirty cubic centimeters with the other, and then pour the solution into the glass syringe and introduce the plunger after the rubber tube and the trocar have become filled with the solution spontaneously.

In forcing in the plunger, if the pressure becomes too great, the intervening rubber tube will dilate before a sufficient amount of pressure has been exerted to injure the capsule of the joint. In injecting the large joints a large trocar is used, but in the smaller joints the trocar should be just large enough to permit the transmission of the iodoform mixture.

Until the pain has subsided the patient should be kept at rest, then a

moderate amount of exercise is useful. The injection is repeated every one to two weeks at first, and less frequently later.

New Preparations.

During the past year we have frequently used two mixtures in place of the above one of iodoform in the treatment of tuberculous joints and tuberculous abscesses. These mixtures have been used with remarkable success by Professor Calot, of France, and we are able to confirm his observations. They are applied precisely like the above iodoform mixture. No. 1 is used in all cases in which the joint contains liquid accumulations, while No. 2 is used where the accumulation is of a consistency too thick to be evacuated through the trocar, and will have the effect of liquefying the accumulation within a week or two, when the treatment should be continued with formula No. 1.

Formula No. 1.

| | |
|-------------------------|---------|
| Iodoform | 5 parts |
| Ether | 10 " |
| Guaicol | 2 " |
| Creosote | 2 " |
| Sterile olive oil | 100 " |

Of this from ten to twenty c. c. are injected into tuberculous joints or tuberculous abscess cavities after the fluid has been evacuated. This is repeated once a week at first and less frequently later.

Formula No. 2.

| | |
|---------------|----------|
| Camphor | 2 parts. |
| Thymol .. | 1 " |

Of this solution five c. c. are injected once a week until the accumulation in the joint becomes liquid.

Beck's Bismuth Paste.

In all cases in which operations are followed by the persistence of sinuses Beck's bismuth paste, consisting of one part of arsenic-free subnitrate of bismuth in two parts of sterile yellow vaseline, should be injected and the external wound closed with a gauze plug. We have heated the paste to one hundred and ten degrees F., and thought that this facilitated the thorough distribution of the substance to all parts of the sinuses, but others have applied it cold with apparently excellent results.

Care should be taken to inject just enough to fill all parts of the sinuses, but not enough to cause a rupture of any of the canals.

The injection should be made daily at first and less frequently later. In case of large cavities it is best not to fill the entire cavity at first until the patient's tolerance has been established. In case of poisoning the patient's gums will become sore and later a black line will develop. The patient will feel depressed. He may or may not have an elevation of temperature.

In these cases the sinuses or cavities should be filled with olive oil heated to one hundred and ten degrees F., and drainage tubes should be inserted for the free evacuation of the paste diluted with the hot oil. This should be repeated daily until the patient's condition has improved.

With fair caution, there is little danger from poisoning, but the possibility should always be remembered.

Beck's paste is one of the most valuable remedies ever introduced into the treatment of tubercular sinuses, and the results obtainable by its careful use are most satisfactory.

THE TREATMENT OF CRUSHING INJURIES OF THE EXTREMITIES.

In the treatment of crushing injuries and lacerated wounds of the extremities, the point of first importance lies in securing, as nearly as possible, aseptic conditions.

It is interesting to observe the marked difference in the difficulty one experiences in obtaining such a result in different classes of patients. For persons who are strong and healthy, who live in hygienic surroundings and are cleanly in their habits, it is relatively easy to secure an aseptic wound after one of these injuries. This is ordinarily the condition of railroad employes, skilled mechanics in factories, men employed in the iron mines in the northern part of this country, and in farmers; but not that of the shiftless who are injured in the streets. Persons who have been employed about horses are more likely to suffer from tetanus than others. This is also true of those who have been injured upon the highways.

The fact that mechanics are likely to have their hands covered with oil and particles of iron and other metal does not indicate that it will be difficult to secure aseptic conditions, as this form of dirt is usually very clean from a surgical standpoint. The oil contained in this dirt has in itself an inhibitory effect upon the development of micro-organisms.

If the injury be severe, it is usually best to anesthetize the patient, because this will enable the surgeon to be more thorough in cleansing the wound. If it is necessary to transport the patient some distance to his home or to a hospital, before it is possible to proceed with the cleansing of the wound, it is best to apply about the extremity a compress of aseptic gauze, wrung out of an antiseptic solution. For this purpose 1 in 2,000 of corrosive sublimate in water is usually most convenient, because it can be prepared wherever it is possible to obtain sterile water, provided the surgeon has with him some tablets of definite size. Any one of a number of other antiseptic solutions may be substituted, such as three per cent. carbolic acid, saturated solution of boric acid, or thirty per cent. solution of alcohol. If water is not available it will suffice to cover the wound with aseptic gauze after the hemorrhage has been controlled, which is, of course, always the first step necessary.

Control of Hemorrhage.

If the vessel can be caught with hemostatic forceps and ligated, such method is most convenient. If this is not possible a suture may be passed around the bleeding point, and the same ligated. If there is simply oozing from a large surface, this may be controlled by pressure, by applying a gauze tampon, to be held in place by a roller bandage.

In some instances, it is best simply to keep the extremity in an elevated position until an elastic constrictor can be applied, and the wound disinfected and the vessel ligated.

If the palmar arch has been injured, and the hemorrhage cannot be controlled by the application of ligatures or hemostatic forceps, the arm may be elevated permanently for several days by applying rubber adhesive straps to the forearm, attaching these to a cross-piece, and to this a cord,

which passes over a pulley suspended to the ceiling, or upon a frame to a weight, which will keep the extremity elevated comfortably. An elastic constrictor should never be kept in position for any lengthened period. It is not safe for more than two or three hours at a time, and even this may give rise to gangrene in some cases, especially if the patient be advanced in age and suffering from endarteritis.

Usually the disinfection may be thoroughly accomplished in less than half an hour.

Disinfection.

If the extremity is covered with black, oily dirt, common in mechanics, it is best to first wash with kerosene or some other form of coal oil. Then soap and hot water, with a piece of gauze, should be thoroughly used, then sterile water, then some antiseptic solution, such as 1 to 2,000 corrosive sublimate, or three per cent. carbolic acid in hot water.

If there is still some doubt, the entire wound may be washed with ninety-five per cent. carbolic acid for one to three minutes and then with strong alcohol until the tissues have a normal appearance.

If the wound has been covered with street dust, or the patient has worked among horses, it seems best to apply strong compound tincture of iodine to the entire surface, and then rub iodoform over the whole part, because it is claimed that this treatment will prevent infection with the tetanus bacillus, and our own observations appear to confirm this theory. There is, however, no doubt but that the point of greatest importance is the thoroughness with which the wound is scrubbed, so that all particles of dirt may be removed mechanically.

If a hand or finger, or any other part of an extremity, has been entirely crushed off, the remaining stump may be trimmed up at once, care being taken to sacrifice as little tissue as possible; but in the vast majority of crushing injuries it is much better for the patient if only the complete disinfection is accomplished at once, and the wound left wide open, so that the tissues may have free drainage; this will aid in preventing infection, and will favor the recovery of tissues which seem hopelessly damaged at the time of the injury or first examination. Leaving the wound without suturing until the tissues have recovered, also favors return circulation, because none of the vessels will then be constricted by stitches. Many times a very useful skin flap will become gangrenous because of the venous stasis resulting from the application of sutures directly after an injury has occurred, and before the circulation has become re-established.

For the reasons mentioned, primary amputations after crushing injuries are but rarely indicated.

It would, however, be eminently unsafe to leave these crushed tissues attached to an extremity if the surgeon were careless in his disinfection, but if he is thorough it will result in great benefit to the patient. If, however, the crushed tissue is septic when the patient comes under the surgeon's care, the conditions are entirely changed, for then not only the crushed portion may be lost, but the infection may result in a pyemia and the patient's life endangered. Here the plan of treatment should be followed that was described in connection with septic infections of the extremities. After the infection has subsided, an operation may be performed, which will be indicated by the condition of the tissues. Any necrotic portions will have been removed from time to time while the treatment has caused the septic infection to subside.

If, however, the patient comes under the surgeon's care reasonably early, the danger of a serious infection is very slight, provided the wound be thoroughly disinfected and left wide open, as mentioned above, so that drainage will be good, and the return circulation favored by elevating the extremity, and complete rest of the extremity is enforced, so that any unavoidable slight infection will not be pumped through the lymphatics in a proximal direction.

In case any pockets of local infection have been formed, these should be laid wide open, the incision in each case being carried parallel with, and not through, the important anatomical structures in the part involved.

If there are any projecting shreds of tissue that cannot possibly be utilized at any future time, these should be cut away, but no tissue, no matter how irregular, which might be used in a plastic way should be sacrificed until it is known just how much may be saved.

Too much stress has been laid upon the importance of the destruction of large arteries or veins in cases where it seemed wise to amputate at once, under the impression that gangrene would certainly occur from the destruction of important vessels. There are many instances in which anomalies have existed, which could not be determined at the time of the injury, or in which there has been an unexpected degree of compensatory circulation, so that an extremity which was theoretically doomed could be saved entirely, or to a great extent. It should, however, be remembered that one may take these chances only when it is possible to so thoroughly disinfect these wounds that we need not fear a dangerous infection by a waiting, conservative plan of treatment. If we are not competent to secure this condition, then we must abide by the rules laid down at a time when all were equally handicapped.

In case a joint of considerable size has been opened, the course of treatment to be followed will depend largely upon the judgment of the surgeon. If it seems likely from the conditions present that an infection has taken place, it will be safest to lay the joint widely open, being careful, however, not to increase the infection, and to disinfect it in the same thorough manner as the other tissues. If it seems fairly certain that no infection has taken place, then it will be best to disinfect the wound in the joint as described above, and then to close the latter with a few catgut sutures and leave the remaining wound wide open. Too much importance cannot be given the fact that it is an easy matter to infect an open joint, and that consequently it should receive the first attention, and should then be guarded carefully until the remaining portions of the wound have been thoroughly aseptized.

What has been said of the larger joints is true of the metatarsal and phalangeal joints, but it is much less difficult to disinfect these, and consequently there is less danger to the patient.

CRUSHING INJURIES TO BONES.

The large bones have been considered in speaking of compound fractures, and the same principles should be carried out in the treatment of crushing injuries of the smaller bones; fragments which are entirely loose should be removed, and irregular ends should be trimmed with bone-cutting forceps. Rough ends of bones into which dirt has been ground so thoroughly that it cannot be removed should be trimmed in the same manner.

Dressing.

If it is convenient, the following dressing should be employed in wounds of the extremities. A saturated solution of boric acid in hot water, to which one-third, by volume, of strong commercial alcohol has been added, should be used to moisten the aseptic gauze which is applied directly to the wound. If there is any reason for fearing tetanus infection, a few layers nearest the wound should be composed of iodoform gauze. Over this a thick layer of cotton is applied, and over all a soft roller bandage. If there is an increase in temperature the entire dressing should be surrounded by a rubber sheet, and from a pint to a quart of the same solution poured into the dressing every three to six hours. The quantity should be regulated by the size of the dressing, and the rapidity with which the moisture disappears.

If it is not possible to apply a moist dressing the surface should be lightly powdered with iodoform. It should then be covered with iodoform gauze, then with sterile gauze, then with cotton.

The dressings should be applied in such manner that they may be opened without causing unnecessary pain to the patient, so that the wound can be inspected regularly.

If there is a tendency to the occurrence of necrosis the wound should be inspected every day, but if at the first dressing it appears that the nutrition is good, then it will be best to disturb it as seldom as possible until it seems to have recovered sufficiently to make the operation for final repair of the injury proper. The condition of the tissues will determine this. If there are small points of necrosed tissue, it is usually best to wait until the circulation in the adjoining structures has been improved to such an extent that no further necrosis need be feared. If the tissues are trimmed too early, one is likely to remove portions that might be utilized to advantage in repairing defects.

In making the final operation, it is far more important that the ultimate result be satisfactory than that the appearance at the conclusion of the operation be pleasing.

Too often a portion of an extremity is sacrificed in order to obtain a handsome stump. The absence of skin from one-half or, in some instances, even three-fourths of the portion of the extremity involved, no longer makes an amputation imperative, because the surface can be covered with skin-grafts, and if this is done before the wound has existed long enough to produce a great amount of cicatricial tissue the extremity frequently becomes very useful. The fact that nerves have been destroyed for a distance not to exceed ten or twelve centimeters does not make an amputation imperative. Neither is this the case if tendons to the same length have been destroyed, because these structures may be grafted, and although this is not always successful it so frequently results in a satisfactory functional result that it is quite worth while to make the attempt.

In covering large surfaces with skin-grafts, the method which has been described should be carefully followed, for it will result in a substantial, pliable, soft and durable covering, instead of the thin, shiny, adherent skin one encounters so frequently in cases that have been grafted by different methods.

The old rule of preserving the head of the metatarsal bone invariably, if at all possible, and the head of the metacarpal bone in men who work with their hands, should be borne in mind. It is wise to do this even if

there is not sufficient skin to cover the bone. This precaution adds greatly in preserving the usefulness of the hand or foot.

A very small portion of a hand or wrist is valuable to the patient, and every effort should be used to preserve as much as possible of the upper extremity.

In the lower extremity this is also true, unless the ankle joint is involved in the injury and the entire foot destroyed. In such case an amputation through the lower third of the leg will enable the patient to obtain an artificial limb, with which he can walk comfortably and gracefully.

Above this point it is again necessary to save as much of the extremity as possible.

AMPUTATIONS.

In making amputations, the surgeon should strive to obtain a stump in which the scar is not adherent to the end of the bone, so that subsequently there may not be produced an ulcer at the end of the stump, due to the fact that the fixed scar results in constant pressure upon a given point.

The flaps should be cut so that the scar will be exposed to as little pressure as possible. This is accomplished most readily by making the flaps of different length.

The sharp angles of the ends of bones should be trimmed away for the same purpose.

If the patient be a laborer, who is compelled to walk on the soft ground or lift heavy weights, it is often desirable to obtain for him a stump which will support his body directly upon its end. This can be accomplished only by constructing a covering layer of bone for the end of the stump, effected by making the first section a sufficient distance beyond the point at which the final section is to be made, so that when the second section is made, a plate of the projecting portion can be placed across the sawed end as a covering. The flattest surface of the bone is then chosen, and a thin plate sawed upward to the point at which the ultimate section is to be made. The periosteal covering of this part is left in place, but the periosteum of the remaining portion of the bone is stripped upward and protected while this portion of the bone is being sawed off transversely.

The attachment of the plate which is left standing will be weakened by a few strokes of the saw, care being taken not to injure the periosteum. The remaining portion is then broken and the plate which has been thus formed is placed across the end of the bone and sutured in position by means of a few stitches of catgut passed through the periosteum.

The operation is completed in the ordinary way.

At the lower end of the femur this method can be accomplished by making a transverse section through the condyles and sawing off the lower surface of the patella.

In the upper extremity, there is, of course, never any occasion for bearing weight upon the end of the stump, hence there is no necessity for special provision against having the scar opposite the end of the stump.

For this reason the circular method has become popular for amputation of the upper extremity.

It is very important that the flaps be cut long enough to prevent tension. The larger nerves should be found, drawn down and cut off two to five centimeters from the end of the stump in order to prevent their adhesion to the scar. At the end of a nerve of considerable size, it is best to

make a V-shaped section, which will permit the two ends to fall together and form a rounded point, which has a tendency to prevent the formation of an amputation neuroma.

The sutures should be drawn only tightly enough to secure coaptation.

Hemorrhage should be controlled very accurately, so that the flaps will not be separated by blood clots.

In case the wound is not perfectly dry, or if one cannot be absolutely certain that it is aseptic, drainage should be employed. This may be accomplished by the introduction of rubber drainage tubes, or by passing through the wound a number of strands of catgut or silkworm gut.

The greatest care should be exercised to prevent infection, as this favors the formation of pressure neuromata and adherent scars, both conditions being sure to cause great discomfort, if not complete disability.

The stump should be dressed with a sufficient amount of gauze and cotton to permit the application of mild, uniform pressure by means of a soft roller bandage.

Rest is one of the most important elements necessary for perfect healing, and this may be most readily attained by applying a splint in every case in which it is possible. The extremity should be elevated, in order to favor return circulation.

In many of these cases, a much better functional result may be obtained by simply trimming away the portions which cannot be utilized, after the circulation in the flaps has recovered sufficiently, and then suturing the remaining portions in the best position possible, and, later, covering the remaining surfaces with skin grafts, than if a complete operation is performed at once. It is often possible to preserve a considerable portion of the extremity which would otherwise have been sacrificed. Many times one or two phalanges of a finger may be saved in this manner, which is a very important matter, especially to a workingman.

SENILE GANGRENE.

Gangrene not directly resulting from severe traumatism or septic infection is most commonly due to a thrombosis of one or more arteries. In aged persons this is usually dependent upon arterio-sclerosis. Its immediate location is determined by an acute endarteritis which may be the result of a slight traumatism or exposure to cold, not sufficient in either case to affect blood vessels in their normal condition.

The patient feels a severe pain, usually along the course of one of the larger arteries in one of his lower extremities. Upon examination, the part of the extremity beyond the region of pain is cold to the touch. For a short time after the beginning of the difficulty the skin is white; later it becomes red, still later purple, and then black. Before it becomes black numerous blebs usually form. The area affected is at first not circumscribed, but there is a gradual departure from the normal appearance toward the proximal end of the extremity, which changes into the perfectly black at the distal end. The latter condition may extend over but a small portion of one toe, or it may include one or more of these extremities, or the entire foot, or a large portion of the leg.

Usually the morbidity progresses upwards as the thrombus increases in extent. Many times the circulation through the smaller branches of arteries is increased because the communicating branches are dilated, and

then the condition will subside and portions which have not yet become black, but which seemed to approach that state, may recover partly or completely. This tendency may be favored by keeping the extremity slightly elevated, to encourage return circulation, and by keeping the temperature as nearly normal as possible by applying artificial heat.

In the meantime the part should be kept covered with an aseptic dressing, which will prevent infection from without. It is well to wash the skin with strong alcohol each day, when a fresh dressing is applied.

For a number of years the opinion has prevailed among surgeons that it is best to make an amputation high up on the extremity early in such an attack, in order to prevent the thrombosis from extending upward into the common iliac artery and thence to the same vessel on the opposite side. It seems that this theory cannot be supported by our own experience, and consequently we advise the plan which has been found most satisfactory in our experience. It is to be borne in mind, however, that this is an open question as yet, and that the plan here advised should consequently not be accepted as final.

Our patients have fared best when we have kept the extremity as aseptic as possible until the line of demarcation had formed. If this occurred at any point at which an amputation would result in a useful stump that point was chosen for the amputation. If a more useful stump could be secured by making the amputation higher up then that location was selected.

In making the amputation three requirements are observed:

1. The extremity is elevated in order to make the field of operation bloodless by the aid of gravitation. It is kept in this position throughout the operation, no constrictor of any kind being employed.

2. The flaps are made ample, so that they cover the end of the stump without the slightest amount of stretching.

3. No sutures are employed for closing the wound, the flaps being simply placed in apposition and a large, rather loose dressing applied to hold them in place.

The extremity is then placed in a slightly elevated position to favor return circulation. It will be seen that these precautions are intended to prevent impairment of the circulation, which is already greatly hampered.

By following these precautions the results have been very satisfactory.

After the circulation has become thoroughly established in the flaps it is safe to apply secondary sutures at any point at which satisfactory union has not taken place, or where the coaptation of the skin has not been effected.

It is important that the patient be guarded against exposing himself in the future to the circumstances which acted as exciting causes of the difficulty. He should avoid traumatism, cold and infection. His general hygienic conditions should be improved and his diet regulated.

DIABETIC GANGRENE.

It has been observed that an operation upon a patient suffering from diabetic gangrene is likely to be followed by death within a very few days, in fact, usually within two days, with the symptoms of diabetic coma. This fact has induced many surgeons to absolutely advise against surgical intervention in cases of gangrene complicated by diabetes. This course will

disable the patient for a long period of time, if not permanently, and it exposes him to the danger of an intercurrent septic infection, which is very likely to occur sooner or later, because the tissues in diabetic patients seem especially well suited as culture media for pathogenic micro-organisms.

But in a large proportion of these cases it is not necessary to follow this plan of denial of surgical relief, for with proper precautionary treatment, it is possible to improve the condition to such an extent that they will bear amputations almost as well as patients suffering from uncomplicated senile gangrene.

The important features of such preparatory treatment consist in giving large quantities of distilled water, from two to six quarts per day, until the thirst has entirely disappeared, which is usually accomplished within two weeks, and after this the quantity of distilled water is regulated by the patient's desire. A moderate anti-diabetic diet is given—a diet which should be free from sugar, poor in starches, but in which vegetables may be eaten very freely. The diet should further contain considerable fat, especially olive oil, if it is agreeable to the patient. In order to determine the extent of improvement in the patient's condition, it is, of course, necessary to make a quantitative analysis of the urine from time to time.

When the patient's physical state has improved satisfactorily, the amputation should be made precisely as in senile gangrene, but the greatest speed should be exercised and the slightest possible amount of traumatism inflicted. There seems to be no small danger from the late effects of anesthetics in these cases, and consequently the time of anesthesia should be reduced as much as is compatible with careful surgical work.

The same precautions in after-treatment should be employed as following the operation for senile gangrene, but especial attention should be given to the diet of these patients throughout the remainder of their lives.

INGROWN TOE NAIL.

The suffering brought about by this condition is very considerable and out of proportion to the simple character of the lesion. It is usually the result of tight shoes and the trimming of the toe nail too close at the corners. When the first pain is felt an attempt is made to cut away the edge of the nail to prevent pressure. Each time the nail is usually cut a little farther back and the condition gradually grows worse. The nail of the great toe should always be cut straight across.

In the very mild cases relief may be obtained by always cutting the nail square across and wearing properly fitted shoes.

Operative Treatment.

In some of the very pronounced cases where both edges of the nail are involved, it may be wise to remove the entire toe nail. In the majority, however, it is only necessary to remove about one-fourth of the nail. This can easily be done under local anesthesia.

Technique.

A small rubber drainage tube used as a constrictor is placed around the base of the great toe. A solution of 1:1000 cocaine is now injected subcutaneously at the base and side of the nail and underneath the nail. An incision is then made down through the nail and its matrix parallel to its long axis, on a line so that about one-fourth of the nail may be removed.

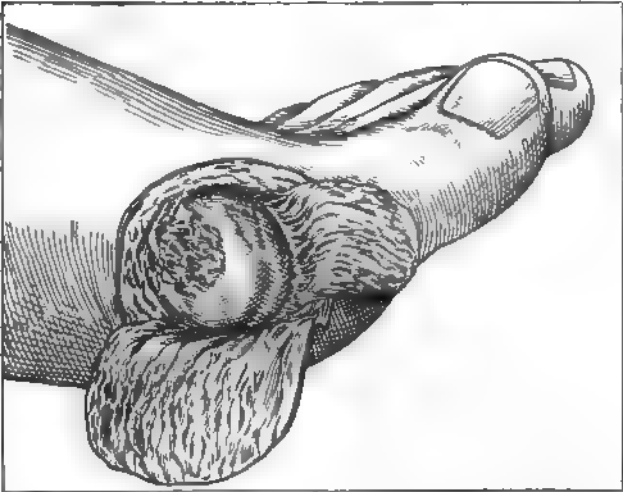


Fig. 26.
Shows skin flap and bursal flap in Mayo's operation for bunion.

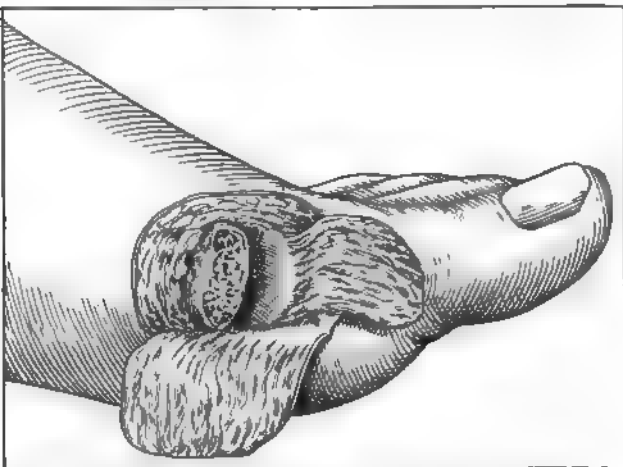


Fig. 27.
Shows end of metatarsal bone after its enlarged head has been removed (Mayo).



Fig. 28.
Shows bursal flap sutured into the joint cavity (Mayo).

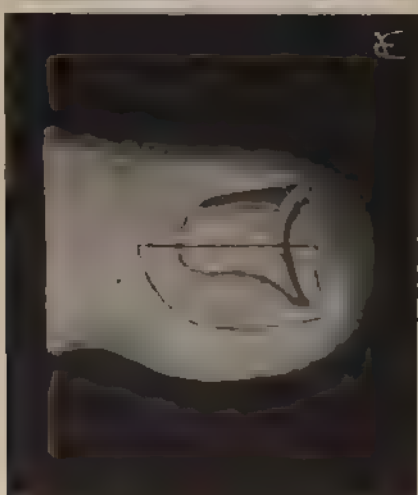
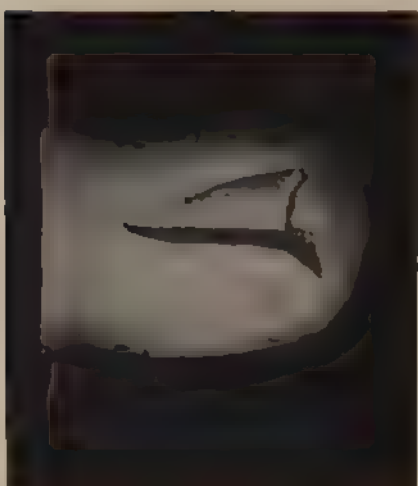


PLATE CLVIII
Ingrown toe nail

(Plate CLVIII.) This one-fourth of the nail, together with its matrix and the granulation tissue along the edge, is carefully dissected away. A wedge-shaped piece of tissue is removed at the base and just below the lower end of the nail, and the defect closed with a few horse hair stitches.

A rather firm dry sterile dressing should be applied before the rubber tourniquet is removed.

The results from this operation are invariably good.

BUNION.

Bunion is quite common but is usually looked upon as a very trivial affair, although the discomfort suffered by patients afflicted therewith is very great. The condition is usually associated with hallux valgus.

Among the various causes the wearing of pointed, short and tight shoes is the most important. Rheumatic arthritis may be a contributing cause. Patients with a long great toe seem more liable to develop a condition of hallux valgus, with the formation of a bunion, than those with a short great toe.

In cases of well marked bunion there is a true bony enlargement on the inner side of the head of the metatarsal bone of the great toe, which becomes covered with a bursal layer.

Treatment.

In cases where the deformity is only slight, the wearing of properly fitted shoes will often relieve them, but in the more pronounced forms an operation is the only method that affords relief.

Operation.

During the past few years we have used the method of placing a flap of the bursa down over the end of the resected metatarsal bone after the method of C. H. Mayo.

A curved incision with its base downwards is made over the inner side of the metatarso-phalangeal joint and a flap of skin is dissected loose leaving the bursa intact. A horse-shoe shaped incision is then made with its base on the phalangeal side of the joint, loosening the bursa and folding it downward, as shown in Fig. 26. The enlarged head of the metatarsal bone is now removed by using a pair of heavy bone-cutting forceps. Fig. 27 shows the bursal flap folded downwards and the metatarsal bone after its enlarged head has been removed. The bursal flap is now turned into the joint area in front of the cut end of the bone and held in place by a couple of cat-gut stitches as shown in Fig. 28. A small puncture is made in the base of the skin flap for drainage and then the skin is closed by horsehair stitches.

In applying the dressing a folded piece of gauze should be placed between the great and second toes to overcome the valgus position of the great toe. The placing of the bursa in the joint area prevents a bony union, leaving a movable joint. The great toe is shortened and the foot somewhat narrowed at its widest line.

PART XI.

THE SURGICAL HOSPITAL.

In order to do surgical work successfully, it is necessary for the surgeon to be able to secure for his patients proper hospital care. An artisan doing his work by going from house to house cannot compete with another who does the same class of work in a well equipped workshop, and the latter will again do better work in his own shop than he would in any other in which he might execute one piece of work. The surgeon of average ability and experience will usually do much better work in his own hospital, with his own assistant and nurses, than can be done by another, for instance, of much greater skill in a hospital in which neither the nurses nor the assistants are thoroughly familiar with his methods and technique. For these leading reasons, and many others which, however, refer more particularly to personal comfort, professional reputation and financial success, every surgeon should have a hospital, or a definite portion of a hospital, in which he can pursue his work systematically and after some definite plan that is in keeping with his technical ability, and which will enable him to perform the immediate work he has to do in the best possible way, and also enable him to make such progress from year to year as is possible under the conditions surrounding. Only the progressive surgeon can continue to prosper under existing conditions of competition.

In planning a surgical hospital, or a surgical department of a general hospital, it is important to secure primarily the greatest possible facility for caring for patients. Facilities which will give the patient the best obtainable conditions for a rapid recovery, combined with the greatest possible comfort while in the hospital. At the same time it is important to keep the cost of construction as low as consistent with securing the above. In doing this, however, it is important always to bear in mind that the running expenses of a hospital amount to as much every three to five years as the original cost of the buildings, hence it is of the greatest importance to plan construction so as to insure economy in the running expenses of the institution. In this manner a given amount of money will readily produce much greater advantage if the plans are properly made than if little or no attention is given to these important features.

It should be stated here that it is always wise to secure expert advice in the construction of hospitals. No one would think of employing an oculist to remove a stone from the ureter, or to make a gastro-enterostomy, and still it would be quite as reasonable to do this as for a surgeon who has had no experience in constructing a hospital to make his own plans, or to entrust this to an architect who has never made a special study of hospital construction, but rather has given his entire attention to the building of residences, stores or manufacturing plants.

It is advisable for the surgeon to make his own outlines, according to arrangements he has seen in other hospitals, then to have a local architect make preliminary drawings. Then he should employ the best available architect who has made a special study of hospital construction and they together should thoroughly revise such plans. Then the local architect should carefully complete these drawings, but before these are turned over to the builder they should again be corrected in every detail by the specialist in hospital architecture. We have repeatedly seen this course followed with the result of saving from twenty to fifty per cent. in cost of construction, an equal increase in efficiency and consequent reduction in cost of maintenance for the entire time that the hospital is in use after its completion.

During the past few years hundreds upon hundreds of new hospitals have been constructed in the various American cities and towns, and it is an interesting fact that in almost every instance these structures have been planned by people who had previously given the subject of hospital construction and location little if any attention.

Architecture.

A local committee usually employs a local architect who consults the essays on hospital construction prepared more than thirty years ago by the authorities of Johns Hopkins Hospital (*Hospital Construction and Organization*, Baltimore, 1875). He may even go so far as to visit a few of the existing hospitals nearby, chiefly for the inspection of apparatus and operating rooms. He may also get the advice of one or more physicians who have never given the slightest attention to hospital construction, and with this preliminary preparation the building is planned and completed.

The result will depend largely upon the special line in which the architect has been active. If he has been in the habit of specializing in the planning of cottages his hospital plans will contain the characteristics of a cottage; if he has mostly built flat or apartment buildings their special features will be contained in the plans and so on through the entire list of architectural specialties from the construction of grain elevators to churches.

In making an investigation concerning the construction of hospitals in the U. S., Bertrand E. Taylor (*Brickbuilder*, March, 1904), found that a vast majority of all hospitals at the present time were originally constructed for some other purpose, old buildings having been adapted. He also states that the new hospitals have generally been designed by architects of brilliant attainments, but who were generally totally unfamiliar with even the rudiments of hospital requirements.

The excellent work of Henry G. Burdett (*Hospitals and Asylums of the World*, London, 1893) is sometimes consulted, but this again simply repeats the ideas which were laid down in the essays just mentioned. The same is true if the various German books and pamphlets are consulted, for in all of these practically the plan of the Hamburg Hospital at Eppendorf is taken as the best type, and this was completed twenty years ago, and planned long before that time.

So thoroughly have these ideas taken root that in many instances enormous sums of money have been spent with the result that all of the patients are compelled to exist near the ground, where the air is least wholesome, most thoroughly laden with dampness of the soil and with street dust. Moreover, the amount of sunlight is greatly interfered with, because so large a proportion of the available land is either directly covered with

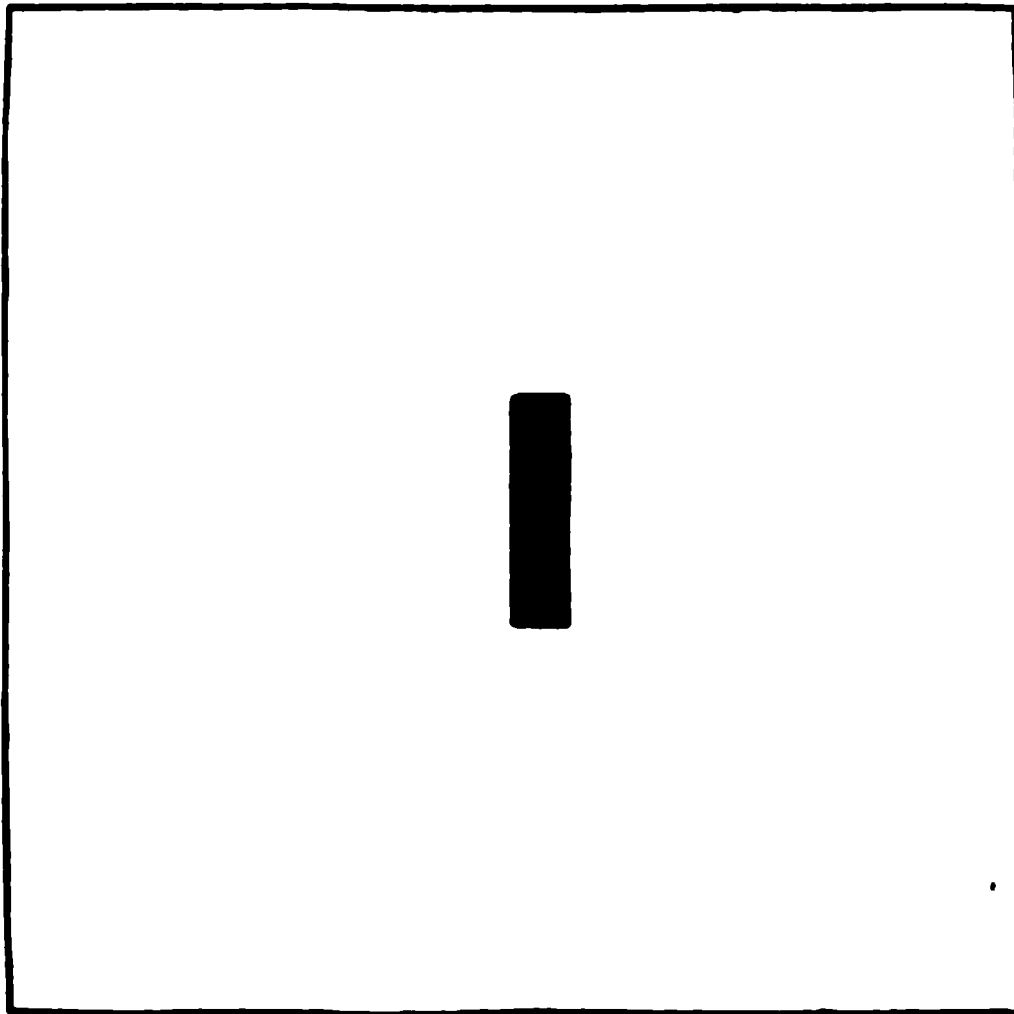


Fig. 29.

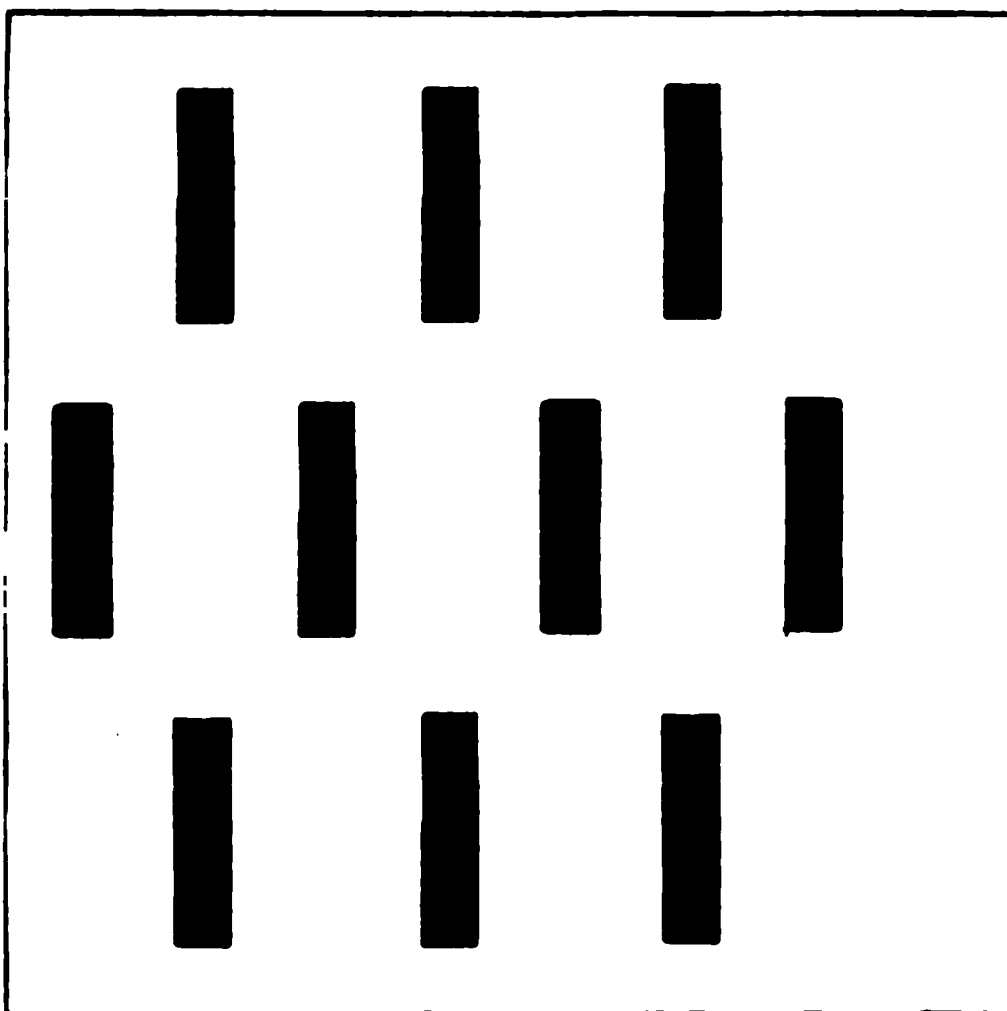
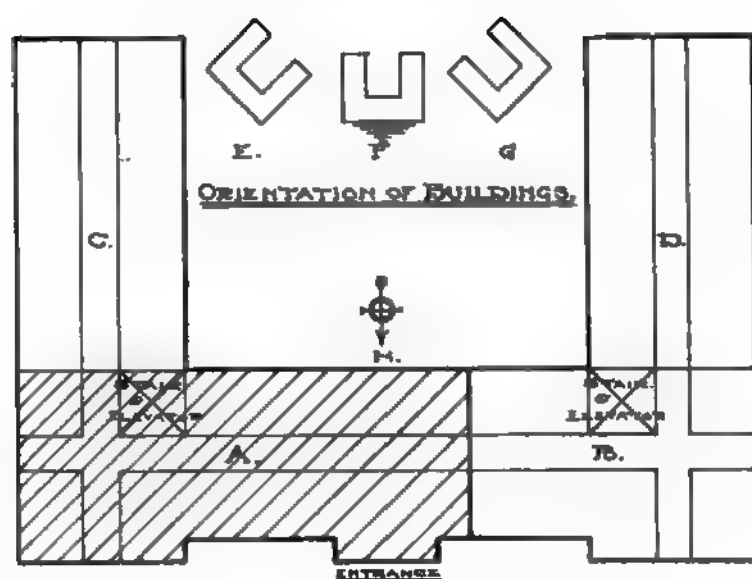


Fig. 30.

Fig. 29. shows the amount of space occupied by a ten-story building in the middle of a ten-acre lot, extending from north to south, so that all the rooms have either east or west sunlight and the hall has sunlight from the south. Such a building would supply almost dustless air in almost any location if shrubbery and trees were planted along the edges of the lot. It would be much more sanitary than if the same number of patients were housed in ten one-story buildings, as shown in Fig. 30, and the cost of construction and maintenance would be very much less in the former than in the latter.

PROPOSED BLOCK PLAN.
STEATHSONA HOSPITAL, STEATHSONA ALBERTA CAN.



BLOCK PLAN SHOWING UNITS FOR ULTIMATE PLAN.

MAYOR J. STEATH HOSPITAL ARCHT
CHICAGO ILL. U.S.A.

Fig. 31.

The shaded lines show the portion first constructed.

If this building is placed in the position shown in E or G, every portion of every outside wall will be covered with sunlight at some time of the day; if placed as at F, the entire north side of the building is not exposed to sunlight at any time of day. It is possible to overcome this objection by placing the utilities, like elevators, bath-rooms and service-rooms, in this part of the building and leaving the remaining portions for rooms and wards for the patients.

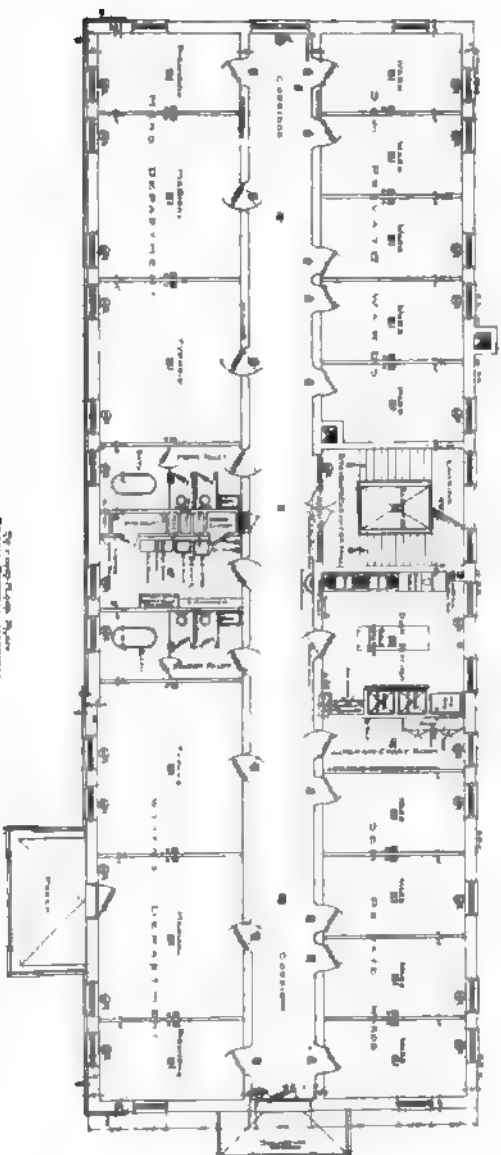


Fig. 32.

(By courtesy of M. J. Sturm, hospital architect.)

This plan shows a very convenient general hospital with elevator and conveniences in the middle of the building, so that these may be reached by the nurses with the slightest amount of walking in caring for the patients in all parts of the building. In this plan all of the stacks in the plumbing are so arranged that they can be readily inspected and repaired without annoyance in the conduct of the hospital. In this building the elevator should extend to the roof, which should contain a central portion with dressing-rooms, service-rooms, bath and toilet-rooms, and the remainder of the roof should be arranged for out-of-door sleeping space.

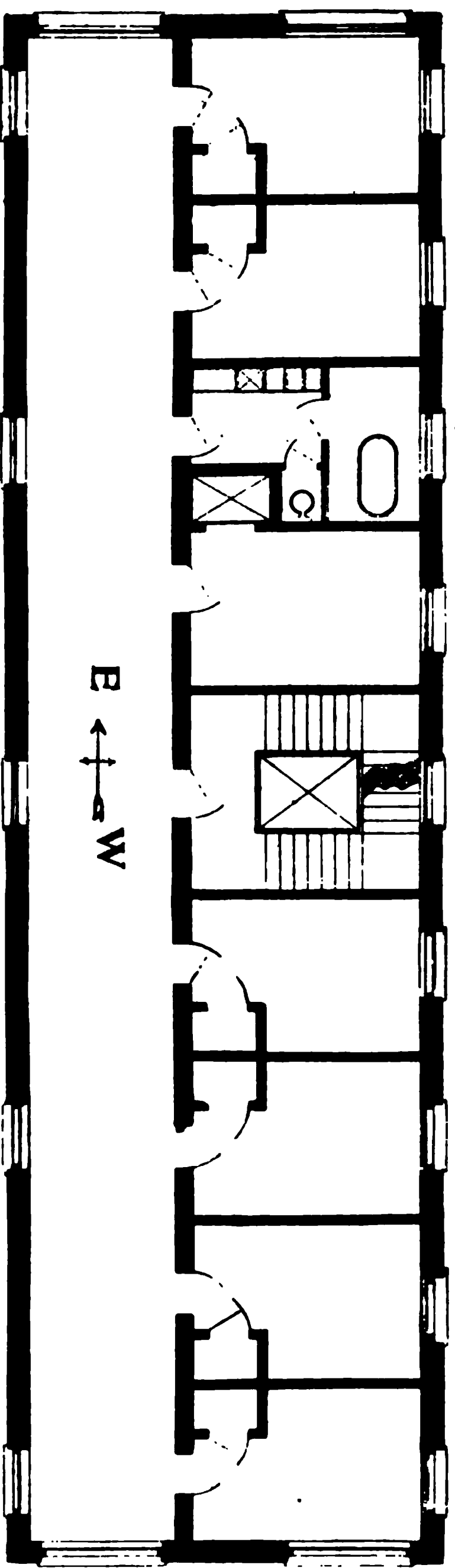


Fig. 33.
(From *Organization, Construction, and Management of Hospitals*, Ochsner and Sturm.)

This represents a very expensive form of hospital, extending from east to west, with all of the rooms facing south. This form of building was very popular some years ago, but it has now been wisely abandoned in most communities.

buildings or is in the shadow of the large number of small buildings required to house the patients.

We refer, of course, to the plan of building a large number of one, or one-and a-half story pavilions, which has of late become especially popular.

As an example we may take the new hospital for the city of Vienna. That city is notoriously dusty. The authorities are constructing thirty-two separate, low buildings which will cover a great portion of the available ground. It will be necessary to place some of these buildings relatively near the surrounding streets, thus exposing the patients not only to the noises of the streets, but to the dust which will easily rise to the height of the first story.

Were it contemplated to erect instead four wings of the same size of foundation, each eight stories high, it is plain that the distance from the surrounding streets could be increased to such an extent that by proper planting of trees and shrubs the air would be so thoroughly filtered by the time it reached the buildings that it would be practically dust free. This would be true especially of the upper floors, but even the first floor would be greatly removed from the dust and noise to which a great portion of all the patients will be exposed if the present idea is carried out.

Location.

The location of hospitals is determined in the same manner. It is chosen because it is cheap; because some philanthropic person has donated it to the committee; because some influential member wishes to dispose of a particular piece of property; because it is in the vicinity of some medical college or some selfish member of the medical staff desires the hospital convenient to his residence in a large proportion of cases; and only rarely because it is especially suited for a hospital site. In the smaller towns very bad locations are usually selected in all cases in which the advice of location is left with the physicians, as from lack of experience they imagine that the hospital will be more prosperous if located near the business center of the town. They also have the foolish idea that the hospital must be within a few blocks of their offices or residences in order that they may readily be available in case of emergencies, forgetting that emergencies are an unimportant factor and rarely occur during office hours.

There are certain fundamental principles which should be borne in mind in the selection of a site for a hospital, no matter whether it be located in a great city or a country town. Of course all conditions are only relative. It is but rarely possible to obtain the ideal in the selection of a site, which has indeed been practically obtained in a few instances, of which we mention that of the Royal Victoria Hospital, in Montreal, but it is possible in every city or town to approximate these conditions much more closely than has been done in ninety per cent. of all hospitals. It should be stated here that this criticism applies to a much less extent, to institutions conducted by sisterhoods than any others, as their selection of sites has in many cases been based upon the following principles.

Absence of Noise.

The site should be in a quiet portion of the city or town, away from noisy railroad tracks, street cars or elevated railroads, or factories. In country towns this may be accomplished easily, and in great cities the location can be chosen at least three blocks away from ordinary railroad tracks.

(Nine-tenths of all of the larger hospitals of Chicago are located directly upon one or two street car tracks, or within two blocks of an ordinary railroad track).

Absence of Dust.

Its location should be so chosen as to reduce exposure to street dust to a minimum. This can best be accomplished by selecting a high knoll in a hilly town, or by setting the building back from the street a considerable distance in a flat city and planting trees and shrubs which will act as natural filters along the edge of the grounds along the streets, and by erecting high buildings. Very little street dust relatively, rises above the second story, so that the higher stories are nearly free from this contamination. In every city there are streets that are comparatively little used. This fact should be considered favorably in the selection of a hospital site.

Sunlight.

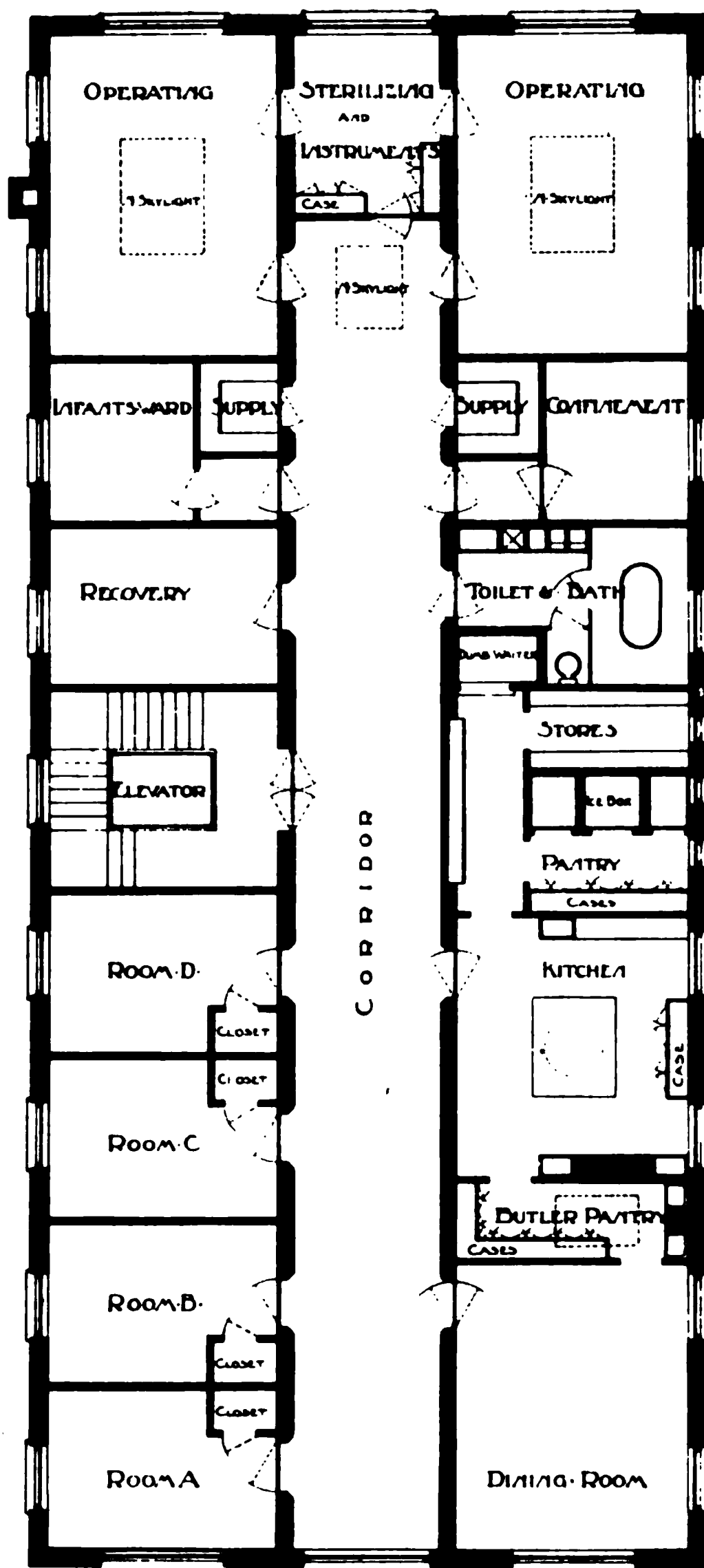
It is so extremely simple to plan a building so that every room and ward will have sunlight during some portion of the day that it is surprising to find many hospital buildings in which one-third or more of the rooms never have a ray of sunlight.

In order to have sunlight in each room and ward it is necessary only to construct all buildings or pavilions from north to south, which will give to one long side sunlight in the morning and to the other side in the afternoon.

The importance of sunlight, its distribution, the production and depth of shadows, together with the bearing this subject has upon the planning of hospitals, has been studied and illustrated with great care by Wm. Atkinson, architect, (*Brickbuilder*, July, 1903). The various shapes of wings have been thoroughly discussed, with a careful consideration of the amount of sunlight and shadow obtained by buildings of the various forms usually employed. This feature has received careful attention in the work on the *Organization, Construction and Management of Hospitals* (Ochsner and Sturm).

At this point it may be well to direct attention to the fact that in long wings with a central hall, with wards or rooms arranged on either side of such hall, two outside and two inside walls will house as many patients as four outside and two inside walls would were the wards or rooms arranged along one outside wall and a hall placed along the other outside wall, and separated from the wards or rooms by an inside partition. This is plainly illustrated in Figs 32 and 33, which represent two typical plans. Fig. 32 shows a hospital extending from north to south in which every room or ward is exposed to sunlight either in the forenoon or afternoon, and the hall during midday. Fig. 33 represents a building extending from east to west with all of the rooms and wards exposed to the sun from the south and with a hall extending along the northern wall.

It is plain that the expense of constructing a hospital for a given number of beds must be at least sixty per cent. greater if plan No. 33 is followed than with plan No. 32, because the additional walls amount to fifty per cent., and there will be required double the amount of outside walls which are, of course, much more expensive. Moreover the same area of hall space serves twice the number of beds in No. 32 that it serves in No. 33.



A GYNECOLOGICAL &
OBSTETRICAL HOSPITAL.

TOP FLOOR PLAN
SCALE 4 FT. = 1 IN.

Fig. 34.

This represents the top floor of a very convenient small hospital extending north and south. At the north end of the building are located two operating rooms with large north windows and large skylights and with an intervening sterilizing room. If the hospital is also to accommodate obstetrical patients, the next room on the east side may be used for obstetrical operations, otherwise it may be used as a recovery room. Directly to the north of the elevator the hall is divided into a north portion to be used in connection with the surgical service, and a south portion to be used in connection with kitchen and dining rooms. This partition is not shown in the figure.

A hospital built according to this plan has been in operation for several years and is eminently satisfactory.



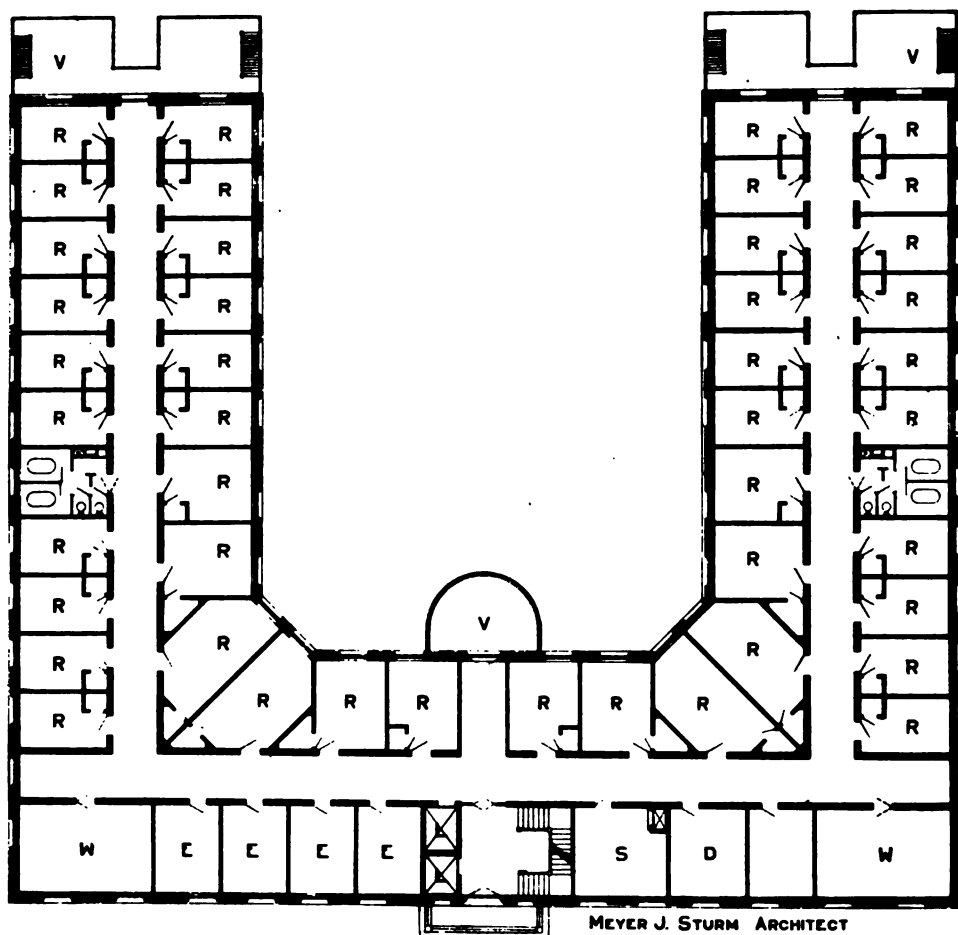


Fig. 35.

(From *Organization, Construction, and Management of Hospitals*, Ochsner and Sturm.)

Represents one floor of a U-shaped hospital of many stories, which combines great convenience, perfect arrangement for sun light, economy in conduct, service, heating, and lighting. It is an ideal plan for a hospital for large cities in which excellence of service and economy in cost of construction, cost of upkeep, and cost of maintenance are important elements. R represents rooms, W small private wards, E rooms for eye patients, S service room, D dressing and examining room, T toilet, L elevator, V veranda. By removing the partitions between two or more of the rooms R, wards may be arranged of any desirable size. All rooms except those used for eye patients have sunlight during some part of the day.

But this is not all; the distance of travel required by those employed in caring for the sick is just doubled. The area of the hall which must be kept clean is twice as great. The number of windows which must be kept clean is approximately twice as great.

Aside from this there is the disadvantage in plan 33 from the fact that twice the surface of outside wall is exposed to the weather and twice the amount of hall space must be heated.

Against this we have the fact that in plan 33 every room is exposed to the south. In most climates it is likely that exposure to sunlight for half the day is equally satisfactory in all except the summer season, and to be preferred in this season.

It seems plain consequently that plan No. 32 is much to be preferred.

Freedom from Smoke.

In many of our great cities there are locations in which there is but rarely any sunshine because of the presence of coal smoke from large furnaces and factories. These locations should of course be avoided in selecting hospital sites.

It is well to note the general direction of winds and to bear in mind the fact that smoke, although very diffusible in the air, will not be distributed to any considerable extent against even the slightest current in the air. It is also important to bear in mind that when the air is apparently still it nevertheless travels at a rate of about one hundred feet per minute, or about as one would move in sauntering along the street, taking a step in two seconds.

Again, in protecting the institution against smoke from any given source one may obtain a fair idea of the entire amount that will be delivered to an institution in still air by taking the distance from that source as the radius of a circle of which the segment corresponding to the length of the institution indicates the relative proportion of the smoke carried to this distance which will be delivered to the institution.

This illustration is employed to show how little of the entire volume of smoke will be delivered to any given space which may be occupied by the hospital in still air, and if the location is wisely chosen with this point in view it is usually possible to have the hospital on the windward side of the sources of especially great smoke producers during the prevailing winds, and thus the smoke nuisance will not be so much of an annoyance as one might expect. Fortunately smoke is usually produced in certain centers so that one may practically avoid them to a very considerable extent, by the careful selection of the site.

Accessibility.

Without disregarding the principles already mentioned it is important that hospitals should be accessible to patients, to their friends, and to the officers of the hospital staff. This is important because it is not well for many acute cases, such as pneumonia, typhoid fever, peritonitis, etc., to be transported a great distance. Since the introduction of properly constructed ambulances in which the stretchers are suspended from the roof upon spiral springs, and in which the wheels are provided with rubber tires, the objection to transportation for a distance of several miles has very little real weight, provided the ambulance service is properly organized. With modern automobile ambulances a distance of ten miles is really of no importance if the roads are good. In large cities ambulances should be built

so that the wheels can run on street car rails which will make the selection of smooth roads always possible.

Great distances are a hardship to the friends of patients who belong to the working classes, because of the time and expense involved in visiting such hospitals, and although it is usually better for the patient if his visitors are few, still the fact that it is difficult for friends to reach a distant hospital frequently serves as a sufficient ground for them to prevent patients who could be best treated in a hospital from availing themselves of this blessing.

Great distance also often prevents physicians and surgeons of the greatest learning and skill from serving upon a hospital staff, as the time spent going to and from the hospital seems too great in proportion to the time spent in actual work therein. But since the adoption of automobiles has become so general, this objection no longer requires consideration, except in very cold climates where their use is not profitable during the winter months.

Hospitals should be located in residence districts of cities and towns under the same conditions which make a location desirable for residence most favorable for a hospital. The nearer such a site is to a park, a lake, high banks of a river, or the seashore, the better.

Size of Grounds.

It is of the greatest importance to have a good-sized area of land, as this will prevent the contamination of the air by immediate neighbors. It will make a free sweep of air possible. The buildings can be set back on the grounds so as to sufficiently secure some of the conditions mentioned above.

A hospital should never be placed between a number of large buildings in the middle of a block—a position too frequently chosen at the present time.

Even in the smaller villages one frequently finds hospitals almost completely filling the grounds. It is practically always possible to secure at least five acres of land for hospital grounds, as in most communities this land is not subject to taxation, and it is always a good investment.

Buildings.

Having chosen a suitable location the question of planning the buildings themselves must be considered.

Forty years ago the theory of isolation of all portions of hospitals from all other portions, received special favor owing to the views then held regarding contamination and infection. It was supposed that an ideal condition would be established if each patient could occupy a separate building supplied with all conveniences.

As this was not practicable it resulted in the planning of hospitals composed of numerous small separate buildings, usually one or two stories in height. There developed a fear of scattering disease from one patient to another through the medium of air contamination. Singularly enough the view was due to the fact that the real cause of contagion had not as yet been established and it was simply known that some diseases were transmitted from patient to patient. It was not then known that definite organisms could be carried from one patient to the other in order to cause this transmission of certain diseases. It is plain that if those who cared for patients in one pavilion could not come in contact with patients in another pavilion, the latter would not be infected from the former.

In this manner a practical solution was found, although this had not been based upon a scientific knowledge of existing facts.

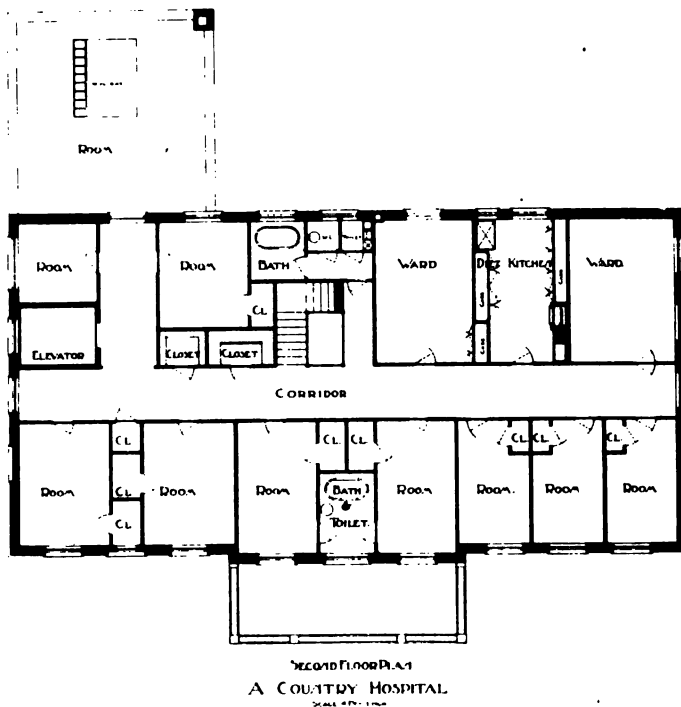


Fig. 36.

(By courtesy of M. J. Sturm, hospital architect.)

We have here a small hospital for a small country town. The building extends north and south, and thus supplies sunlight for all rooms and for the hall, which must have large glass doors at each end. The building may be built one, two, or three stories high. It has all facilities of the modern city hospital.

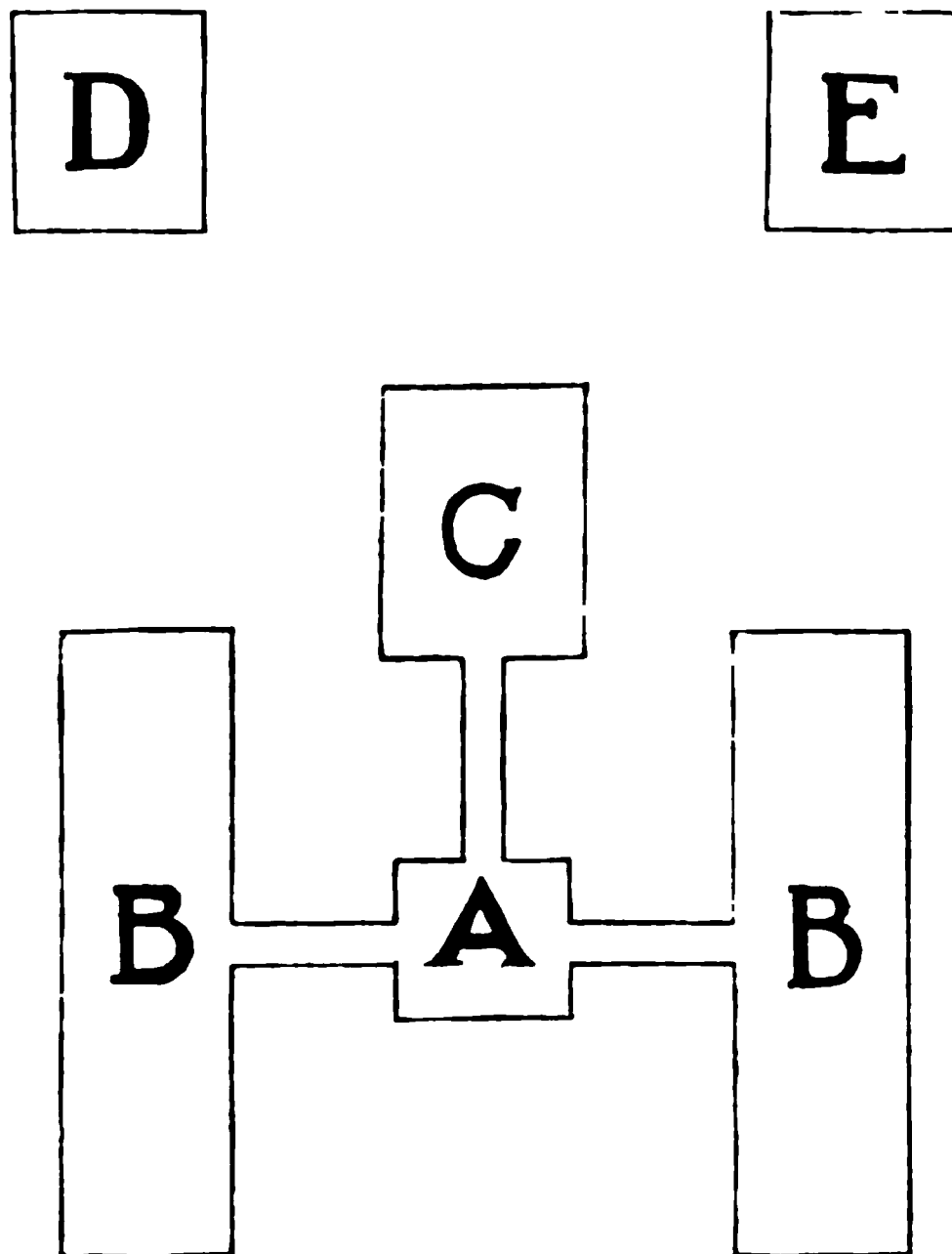


Fig. 37.

This shows the arrangement of buildings for a large hospital in a city of considerable size.

B B represents separate pavilions extending from north to south, one for men, the other for women. They may be constructed in any desirable length and of as many stories as may be wanted. A represents the central administration building, C the operating pavilion, D the home for servants, and E the home for nurses. The basement of the operating department may be used for boiler and engine room on one side and laundry on the other. The first floor may be used for dispensary, or the laundry may be placed on the ground floor of the servants' building, D.

Although we know that there is a definite difference between diseases transmitted from patient to patient, and the very much larger class in which this is not possible, the fundamental idea underlying all hospital construction still centers about this theory of air contamination.

In reviewing recent literature on hospital construction one constantly finds a reiteration of this idea. The various authors seem to be impressed with the danger of the communication of disease from one patient to another, even in non-contagious and non-infectious diseases, and this is an idea expressed not only by architects whose ignorance in this direction would be excusable, but also by members of the medical profession. And yet when one asks hospital physicians of large experience for an example of such an occurrence among the thousands of cases observed one finds that no such instances have happened in the actual experience of those with vast practice.

The knowledge of this fact should make it plain that there should in the first place be a definite isolation of all cases whose disease can be transmitted by contact or by infection, and on the other hand that the other cases should be placed in buildings constructed with a view to securing conditions favorable to the treatment of the diseases involved, and not with a view of securing a degree of isolation which in this very large class is of absolutely no value, but of very great inconvenience and expense.

These patients need an abundance of clean air, sunlight, proper food and excellent nursing in clean rooms, properly heated, and as little disturbed by noises as possible. They should also be protected against danger from fire.

All of these requirements should be secured at as slight an expense as possible, as all available funds can always be employed with benefit even though no money be expended unnecessarily. The follies which have been committed in the way of obtaining a very slight amount of benefit to the patients for the amount of money expended are extraordinary.

It is necessary to study the expense, 1st, from the standpoint of primary cost of construction, and 2nd, from the standpoint of cost of maintenance.

In constructing buildings to house a given number of patients the first and the last stories are always of the greatest expense, as the first story implies the cost of a foundation with its system of drains for the proper disposition of the sewerage. The last story is again expensive because of the necessity of covering it with a suitable roof.

These items may be divided into units of cost where the foundation proper (footings) are taken as one, the cellar or foundation walls as one and the first story as one, the superstructure (roof, walls, etc.) as one. This makes a total of four units for the first story covered, or for a one story building. Each additional story between the first three and the last is an added unit, so that in a six story building we have the original four plus the five added stories, making nine as against twenty-four units for six pavilions of the same area. This will be found to be a fair proportion.

The intermediate stories require no foundation, the same sewer system which serves the first story can be made to serve all of the succeeding stories, and the roof covering the last story will serve all the intervening ones. The only difference lies in the strength of the foundation and the thickness of the walls, which must be proportionate to the height of the building.

It is also absolutely necessary that a high building be supplied with an elevator, and that its construction be thoroughly fire-proof, both conditions not required in a one-story building. But nevertheless the cost of construction

tion of one of these high buildings is much less in proportion to the number of patients housed than that of one-story buildings.

It will readily be seen that the primary cost and maintenance of the plant will be greater in one story pavilion hospitals than in superimposed stories, as in the latter the system is simpler in construction, more direct and so more economical in all ways. This holds especially also for the plumbing, as the superimposed bath-rooms, etc., need but one stack and a vent for each separate tier and can be run more advantageously. Again in the heating of these buildings the amount of heat wasted in cold weather is much greater in one story buildings because of the relatively greater amount of surface exposed to the outer air.

The difference in cost of construction between fireproof and non-fireproof is decreasing constantly, especially so since many of the new so-called "armored concrete" constructions have been brought forward. Some of these are the equal of any construction known and cost but little if any more than first-class frame construction in larger buildings. This is more evident since wood has become scarce and correspondingly costly in the few years. This is of very great importance as it makes it possible to obtain the advantages of housing the patients in a high building away from the noise and dust of the streets and the dampness of the soil, without exposing them to the dangers from fire and without increasing the cost of construction to an unreasonable amount.

The use of the modern elevator and the automatic dumb-waiter make it possible to care for patients in a building of a number of stories at a much smaller expense than when housed in a number of separate cottages.

There is one great danger in the adoption of high buildings for hospitals in the fact that there is a great temptation to decrease the area of the land upon which the hospital is built, while increasing the height of the building. This would, of course, be a fatal error as it would destroy the advantages to be gained from high buildings, especially if the neighboring buildings were also high.

The nearest building should be twice the distance of its height away from the hospital in order that there be no serious interference with sunlight and with the air supply. It is important in designing hospitals to arrange a flat roof properly planned to serve for an out-door sleeping pavilion. In this way the best possible facilities can be obtained for patients to recover from anesthesia after operations and for the care of other patients who may best off in the open air. Of course, the elevator and all other utilities must be provided.

Shape of the Building—Ground Plan.

Much attention has been given to the perfection of ideal ground-plans for hospital buildings. William Atkinson states the principles to be observed in the following concise manner: "First. To secure a large amount of sunlight for each building. Second. To impede as little as possible the circulation of air in and about the building. Third. To provide for the future enlargement of the hospital. Fourth. To promote convenience and economy of administration."

It is plain, that with a building a number of stories high, all of the fundamental principles may be solved in the simplest possible manner.

First. A building constructed on the general plan indicated in Figure 32 furnishes a large amount of sunlight for every room or ward, as well

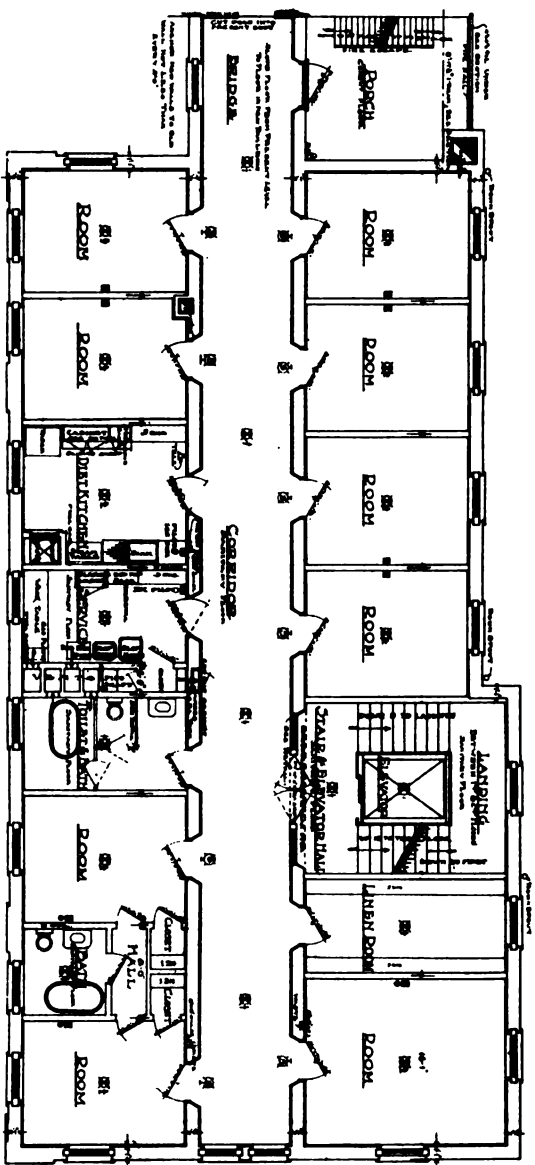


Fig. 38.

(By courtesy of M. J. Sturm, hospital architect.)

Small hospital extending from north to south, so arranged that its capacity can be increased by lengthening the building to the south. At the southwest corner two private rooms are shown with a bath between them, which is an excellent arrangement for the accommodation of the better classes of private patients. The arrangement of general bath room, service room, and diet kitchen is most complete and convenient in this plan and still economical in the use of space.



as for the hall. It is important, however, that the hall extend the entire length of the building and that it be not obstructed by end-rooms or projecting walls at any point in its extent. It is best to construct the end of the hall almost entirely of windows and large glass doors by means of which patients can be wheeled onto the porches.

Second. The higher the building the less will be the obstruction to the air.

Third. Future enlargement may be accomplished by adding more stories, provided the foundation is built sufficiently heavy to permit this.

Fourth. Being compact it must be convenient and economical to manage.

The same author gives a sun plan of the various typical forms which may be given to a ground plan, illustrating with excellent diagrams the amount of sunlight as well as the extent and the depth of shadows produced by each form.

A study of these diagrams will convince any one that the form indicated in Figs. 34 and 35 contains the greatest number of advantages. This plan can be carried out by simply building a single pavilion as shown in Fig. 34 or two or more of these pavilions may be built in a row with a sufficient space between.

These plans may all be united by a one story corridor, or building, which should preferably be placed at the north of the pavilions in order not to throw a shadow upon the land between the various pavilions. In this way another means of enlarging the institution by adding further pavilions may be provided.

Or they may be placed in the form shown in Fig. 35 with the open court facing south, or better still, a little east or west of south. Fig. 36 gives a plan for a small country hospital which represents the same principle. This building must of course also extend from north to south.

In large institutions for the care of the sick in great cities it is well to consider a ground plan, as shown in Fig. 37, in which one wing or tier of pavilions is intended for male, the other for female, patients, the administration building being placed between these two wings at an equal distance from each.

Aside from providing for the housing of the patients it is necessary to make provision for the housing of the officers of the institution, the resident medical staff, the nurses and the servants. Provision must also be made for the administrative offices, for the kitchen, laundry and boilers supplying heat and steam power.

If but a single, many-storied building is chosen it is well to place the offices in the first floor, as well as the rooms for the house staff, the drug room, laboratories and the examining rooms, as this places the patients in the higher stories where they are away from the disturbances naturally occurring on the first floor.

It is usually better to house the servants and nurses in a separate building, so as to compel them to be away from the hospital proper during their time of rest.

It is, however, often more convenient to build the original hospital building sufficiently large to house the patients as well as the servants and nurses at first, and as the latter space is required for patients, to then prepare separate quarters for the nurses and servants.

Kitchen.

In such a building the kitchen should be in the top story, connected to all the stories by means of a dumb-waiter, each story having besides its own diet kitchen and nurses room. This prevents the annoyance which invariably exists from the odors of cooking when the kitchen is in any portion of the building.

Operating Rooms.

The operating rooms should also be in the uppermost story in order to secure the air freest from dust and to prevent annoyance of the other patients during operations, and so the principal light for operating may be obtained through north skylights.

Recovery Rooms.

It is well to provide a number of rooms in this story in which patients may be kept twenty-four hours, or longer, after the operations, so as to prevent the disturbance of other patients in the hospital by those who have just been operated.

In this manner all of the business of the hospital at all likely to disturb patients is conducted in the first and last stories of the building, as far as possible away from the inmates.

Heating.

The problem of heating depends largely upon the climate in which the hospital is located. In most cities in this country it is necessary to provide efficient means of heating hospitals during the cold season of the year.

The most economical form of heating in the colder portions of the country is by direct radiation from steam coils, in the warmer portions the country from hot water coils.

There is no doubt but that air which has come directly in contact with steam coils heated to 212° F. is not nearly as wholesome as that which has not been exposed to so high a degree of heat. With the ordinary steam coil there is, however, only a small proportion of the air contained in the room which comes directly in contact with the coils. The greater portion of the entire amount of the air in a room being heated by contact with the nearer the coil which has been heated, consequently only a portion of the air is spoiled by being overheated by this system.

All systems of combined heating and ventilation by means of indirect heat with forced ventilation are extremely expensive and very unsatisfactory and should be absolutely condemned in hospital construction.

Ventilation.

The question of ventilation is usually discussed in connection with heating, because in cold weather the fresh air brought into a room must first be heated in some manner before being delivered to the patient.

In natural ventilation, which occurs through the walls of the building or through cracks about the doors and windows, the cold air entering is heated by coming in contact with the air already in the room.

Artificial Ventilation.

In artificial ventilation there are still many practical problems which have not been definitely settled.

This kind of ventilation may be accomplished by removing the air in

room by means of fans, or through heated flues in which a draft is caused by the fact that hot air rises, because of its decrease in weight, due to expansion.

The space occupied by the air removed from a room by either of these methods will be filled with air coming from without, either through openings provided at points at which the cold air has to pass over heated radiators, or through a main duct above the roof, and necessary heating coils below the same to a settling chamber, and then by smaller ducts to the various rooms.

Another method consists in forcing air by the use of fans through a chamber heated by coils, thence through flues into the various rooms and wards. This plan may be employed alone or in combination with the methods just mentioned, by means of which the bad air is drawn out of the rooms. But this method has among its leading drawbacks this, that a constant temperature cannot be maintained, owing to external and internal variations and conditions.

(There are always air spaces which contain air which can be displaced only with difficulty, while there are other spaces in which the air can be changed easily, consequently the fresh air will constantly be forced into spaces which are least in need of a change, while other portions of the room will continue to contain vitiated air).

If this plan is chosen, it is important to take the air from a high point and never from the level of the ground, because in this manner air relatively free from dust and moisture of the soil may be obtained.

It is, however, important that the intake be at a point where the air is not vitiated by the bad air forced out of the building, or by smoke from the chimneys, or sewer gas from the soil pipes which project beyond the roof. This may be accomplished by placing the intake to the windward side of the building during the cold season of the year, for it is during such season that the forced ventilation will be in use.

The heat chamber through which the air is forced should be supplied with hot water pipes in which the heat is regulated so as not to exceed 160° F., as air blown over pipes heated with steam to 212° F., loses much of the invigorating effect obtainable from fresh air.

Theoretically it has seemed that a system which combines the plan of withdrawing the vitiated air from the rooms by means of a system of tubes, and fans which force into the rooms at the same time a sufficient amount of air taken from a point at which it is most likely to be pure, would result in the best possible conditions.

In many buildings, not only all of the air, but all of the heat has been supplied in this manner, the air being heated sufficiently in passing over the coils in the hot air chamber to supply the necessary heat.

The great advantage in this system comes from the fact that in order to secure a sufficient amount of heat a great amount of fresh air will have to be supplied, and in this manner the ventilation must necessarily be excellent during the cold season. The amount of heat supplied to each room can be automatically determined.

There are four important objections to this system. 1. The principal reason for rejecting this method lies in the fact that very large ducts and outlet surfaces must be provided, a condition of things which is practically almost impossible in the economic arrangements of a hospital. Smaller

ducts and outlets would not be practicable owing to the velocity of the ingress and egress of air necessary to give both heat and air sufficient to do work. 2. The expense of maintaining it is very great. 3. If the coils heated by steam the air loses much of its invigorating effect because a portion is actually overheated. 4. In autumn and spring it is almost possible to supply a sufficient amount of air to each room without overheating it unless hot water coils are used which are regulated so that the temperature does not exceed 120° F. during the autumn and spring, while later it is raised to 160° F., and as the air passes over the coils more and a greater relative proportion of it comes in direct contact with the coils and is consequently more thoroughly spoiled than in winter. Moreover in winter when large quantities of cold air are blown over the coils the surface of the latter never quite reaches the temperature of the steam contained within, and this in turn prevents the air from being spoiled by overheating.

Whether it would be possible to supply a sufficient amount of heat in very cold weather if the hot air chamber were heated by hot water coils at a temperature not to exceed 160° F. we cannot state because so far as we have been able to learn this plan has not as yet received a practical trial. That this would greatly improve the quality of the warm air there can be no doubt.

It would consequently seem best to supply only the fresh air for ventilation heated in such a chamber while the heat for heating the building would be supplied by direct radiation.

This would at once be economically and hygienically correct. In spring and autumn when only a very small amount of heat is required there would not be necessary to use the steam radiators as a sufficient amount of heat could be supplied with the ventilation.

In buildings in which the air passes over coils heated with steam the atmosphere is most depressing during the months when little heat is required as the volume of fresh air forced into the rooms is smaller than during the coldest season, hence a greater portion comes in contact with the overheated coils, and the surface of these coils is of a higher temperature than when a large amount of cold air is forced over the coils, hence there is not only less air, but the air is of a poorer quality.

During the warm season of the year when no artificial heat is required open windows and straight corridors are of the greatest importance, as well as careful grouping whenever several buildings are constructed, to prevent obstruction to currents of air.

In this again the higher the building the freer will be the currents of air, because of the fact that there must necessarily be less obstruction from surrounding structures and hence the natural ventilation must be better.

Filtering of Air.

The best methods of cleansing air are the natural ones. Air which has been carried across a large body of water is practically free from impurities because these have fallen into the water. Air near the tops of high mountains is pure because impurities fall to the ground before they are carried to these great heights. In tall buildings there are more micro-organisms in the air entering from without in the lower than in the upper floors.

For these reasons it seems wise to obtain as large a piece of land as the means will permit, on the highest available piece of ground, and then put

buildings as near the center of such area as possible. The higher the buildings, the better will be the chances of obtaining good air for the greatest number of patients.

Shrubs and trees planted between the building and the surrounding streets will serve to filter a considerable portion of the street dust out of the air before it reaches the building.

In forcing air into a building for the purpose of ventilation it is possible to select that which is relatively free from dust and impurities if the intake has its opening at a good height somewhere near the roof of the building, but in such a position that the prevailing winds will force the impurities which come from the chimneys and ventpipes away from the intake.

Many devices have been instituted for the purpose of washing the air which is forced into a building by fans. Streams of water are permitted to drip over moist gauze or other substances so as to intercept the fine particles contained in the air. This treatment of the air has, however, not yet been fully and satisfactorily demonstrated, although many authorities speak well of it.

A method which has been used frequently by the government in some of its hospitals, and especially in its larger office buildings, is to heat the air above freezing point and then pass it through a wall of finely sprayed water, there being many of these small apartments about eighteen inches square so as to keep the water from spreading. This is economical as the water can be filtered and used over and over. The air is then sent into a drying room and from there into a space where a fine spray gives it the requisite moisture, the drying room being kept at a temperature so that the air goes out to the several ducts at slightly higher temperature than that of the rooms. The system has been found very satisfactory, exceedingly simple and inexpensive.

Lighting.

Incandescent electric lights are probably the most cleanly, convenient and satisfactory in most cities. In large institutions requiring high pressure steam for other purposes, such as running elevators, pumps, laundry machinery, etc., electricity can be manufactured at a reasonable expense for lighting the building.

If the institution is dependent upon ordinary illuminating gas it is preferable to make use of some one of the various incandescent mantles in the market, as the quality of the light is thus greatly improved, while for the same amount of light the amount of carbon dioxide and smoke are greatly reduced in quantity, moreover it is much easier to regulate the amount of light.

In large institutions acetylene gas may be used economically. The quality of the light is excellent and with proper care the amount of smoke is very slight.

There is some danger of explosions if the apparatus is not handled by a careful person.

Plumbing.

Plumbing in residence and hotel construction has been perfected to such a degree that if the same care is employed in the installment of hygienic plumbing in hospitals there is no reason for change or improvement, with the exception that special facilities are required for disposing of contents of

bed-pans, etc. A large slop sink and hopper, with a water seal which at once dilute any offensive matter thrown into it, has been constructed recently and is of great value. It is provided with syphon together with large plunger which cleanses the entire contrivance thoroughly and at once.

Sterilizing Rooms.

Sterilizers for surgical dressings, sheets, towels, instruments, etc., so perfect as supplied by many manufacturers that it is scarcely necessary to dwell upon them. Sterilizers for mattresses are not so satisfactory as

Floors.

In the halls, bathrooms, closets, kitchens, operating and dressing rooms some form of flooring which is impermeable to moisture, such as tile or glass, has been generally adopted with great satisfaction, as it may be kept clean and is attractive in appearance. The most satisfactory material is known as flake mosaic, especially if this is made in the form of large tiles. In the wards and rooms hardwood floors laid on the cement cover which isolates the floor from the lower story, seems preferable. This should be covered by some dressing impermeable to moisture in order to prevent septic materials from penetrating the pores of the wood. A careful application of grain alcohol shellac closes the pores quite effectually.

The walls should be covered with paint, which prevents the plaster from becoming filled with germs. These walls may be washed and rendered aseptic after the rooms have been occupied by patients with purulating wounds.

In the operating and dressing rooms walls covered with tile, or glazed brick or glass are very attractive, but they are in no way superior to those that have been carefully covered with hard enamel paint which is impervious and acid proof.

HOSPITAL MANAGEMENT.

Concerning the internal management of hospitals there is much to be said, because at the present time no definite system has been established, except in hospitals under the control of sisterhoods that have conducted similar institutions for many years in the past.

In other American hospitals the management, as a rule, is the cause of almost unceasing annoyance to every one connected with the work. In time no doubt, there will be developed as definite systems of management of hospitals as now exist in other departments of human activity. There are no definite plans for conducting almost all other enterprises. One would expect to manage a railroad, bank, department store, saw-mill or any other industry unless one had a definite knowledge of a system according to which such industries were commonly conducted with success, simply because it would not be possible to compete with those who have this knowledge.

It is quite different in the control of hospitals, because any deficit which may occur as the result of incompetent or bad management can readily be made up by contributions from those who are interested in these institutions as public charities. This is true to so great an extent that one almost invariably finds that the institutions which are worst managed are at the same time most generously supported.

Fortunately many of the smaller institutions have but little out

support and consequently their existence depends upon the ability of those in charge to develop a reasonable plan of management, and this condition must in time result in a recognized system which will ultimately become generally adopted.

For the management of smaller hospitals it will be necessary to have nurses educated in training schools not only to do scientific nursing, but also to perform all the other duties connected with the government of hospitals.

Fortunately several training schools for nurses have been organized during the past few years with this end in view, and a number of the older schools have added new departments of instruction in order to enable their pupils to become more broadly educated, with a view of making them more thoroughly competent to manage the great number of new hospitals which are springing up in all parts of this country.

If it is possible to obtain a trained nurse who is familiar with the details of the entire management of a hospital, it is usually best for all of the smaller institutions to vest the entire management of the institution in this office, i. e., the superintendent of nurses.

In order to be competent to occupy this position properly, it will, however, be necessary for the occupant not only to be an excellent nurse, but she must be a good housekeeper, a good business woman, must know how to buy supplies, how to get on with little by economizing in every way. She must know how to select help and how to keep it. She must be a good teacher in order to obtain satisfactory work from the pupil nurses. She must know how to act promptly and quietly in case of emergencies. She must do all of this cheerfully, lest she drive patients away from the hospital, and must consequently have an unlimited amount of good judgment and tact.

Above all things she must be absolutely reliable, and must be looked upon in that spirit by every one connected with the institution.

One quality which in the main depends upon good judgment and tact, but which is but rarely found in persons at the head of hospitals, is a willingness to do what can be done under existing circumstances, although it may not quite approach one's ideals, without grumbling over things which are for the time being impossible.

A person who possesses this quality at once becomes a leader instead of a master and will consequently accomplish vastly more in the end.

Many of the smaller hospitals owe their success, if not their continued existence, in a large measure to the fact that they were able to secure the services of such a person for the leading spirit in the management of the institution.

There are two items which it is important to bear in mind at this point.

It is important to plan the work so that this person has one entire day each week away from the institution, and some time during each day for rest without disturbance. One who has all of the most desirable qualities too often has not the wisdom to take the necessary rest to be able to continue this work to the fullest extent.

The other point is as regards the authority of such a person. She should not be hampered in any way.

It is here that the harmful effect of meddling committees of women's auxiliary boards so often make it impossible to develop a desirable system. In the few hours that a committee, composed of the most excellent ladies of the village or city, give to hospital matters each week they can usually per-

petrate more follies than can be remedied during the remaining day those who give their entire time and thought to the work.

No one who does not practically give all of his or her time to the work should have anything to say concerning the management of the institution, aside from auditing the accounts, and this should be done by an expert accountant whose only duty should consist in determining the correctness of the items.

The board of directors should be divided into various committees, which questions of importance should be referred; but no member of the board should in any way interfere in the conduct of the institution, because it is not at all likely that he will be in possession at any time of sufficient data to make his interference advantageous to the institution. His interference would not be tolerated in any other business enterprise, still it is only too common in the management of hospitals.

It should be thoroughly understood that hospitals can be managed precisely the same principles that one applies to any other successful business enterprise, and that the same principles will result in similar success. This has been demonstrated in a number of the most useful hospitals in this country, and only when this desideratum has become generally accepted and put into practice can we expect the greatest possible amount of benefit to come from these institutions.

All persons performing work in the hospital should be properly paid for their services, otherwise the service is certain to be very inefficient. If the institution will be compelled to feed and house an army of incompetents who would not even be able to earn their board and lodging elsewhere.

The above tenet will make it proper to expect good work from every one employed, and any one who fails to do his share of the work must be dismissed with justice to himself and benefit to the hospital.

Pupil nurses receive their tuition in the form of lectures, class work, recitations, laboratory work and bedside instruction, which should pay for their services in part or in whole. In the larger hospitals this is also true of the members of the resident medical and surgical staff.

The number of assistants, pupil nurses and servants necessary depends entirely upon the size of the hospital and the character of the work to be performed.

In an institution of less than thirty beds it will not be necessary to have a matron or housekeeper. In a larger hospital this will be necessary, but this position should be under that of superintendent of nurses. It is, however, a great advantage to the institution to have a matron who is a graduate of a training school for nurses, because she will be much better able to comprehend the demands upon her department.

The other servants, such as cook, chamber-maids, laundress, janitor, as well as the number of pupil nurses, will depend upon the number of beds.

There are many other items which might be discussed in this connection, but what has been said above will suffice to make clear the most important principles involved in the organization of a hospital.

Supplies.

In purchasing hospital furniture it is important to combine utility with durability, at the same time securing furniture which can easily be kept clean.

For a number of years hospital authorities have neglected to pay

ficient attention to the element of attractiveness so that the beds, for instance, remind one more of cots in a penitentiary than of beds for the use of human beings who need cheerful surroundings.

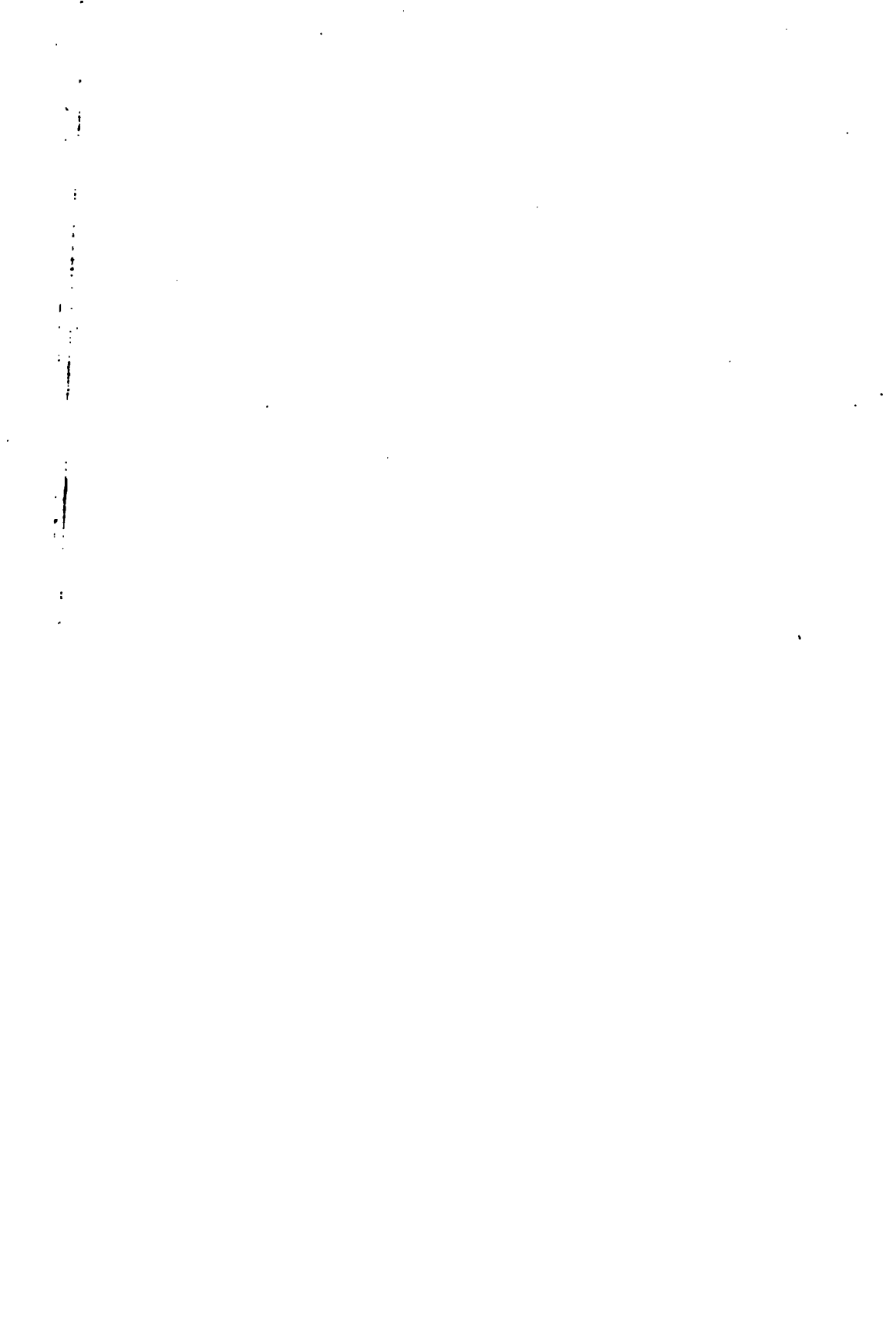
It is now possible to secure attractive hospital beds which are strong, easily cared for and easily kept clean.

The bed for surgical cases should be high so that the top of the mattress is seventy-five cm. from the floor. This makes the work very much easier for the nurses. The beds should be so built that either the upper or the lower end can readily be elevated. It is important to secure good springs for the bed.

The other articles of furniture, like bedside tables, wash stands, etc., should all be well made of plain but artistic pattern and so built that they can readily be kept clean.

The utensils furnished by hospital supply houses are so convenient and so well made that it is not necessary to describe them especially.

There should be a sterilizer on each floor so that all utensils may be sterilized regularly after they have been used.



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